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RESEARCH DIRECTED TOWARD DEFINING THE VARIABILITY OF THE ATMOSPHERE BETWEEN 30 AND 200 KILOMETERS

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GCA CORPORATION

Bedford, Massachusetts

INTERIM REPORT

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RESEARCH DIRECTED TOWARD DEFINING THE VARIABILITY OF THE ATMOSPHERE BETWEEN 30 AND 200 KILOMETERS

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SUMMARY

Owing to the current stringent requirements of various flight and space operations, a rather detailed knowledge of the diurnal, seasonal, and latitudinal variation in upper atmospheric properties, 30 to 200 km, is becoming increasingly important. Considerable work is required to adequately define the detailed variability of the atmosphere at these altitudes. A major accomplishment of a continuing investigation of upper atmospheric models has been the compilation of over 400 rocket and optical probe soundings performed since 1947. The present interim document reports on current work involving continued up-dating of data collection and further analysis of the data at hand. A specific discussion of Soviet rocket soundings, a significant percentage of the total number, is included. A computer program was written and run which reprocessed and transferred the original data collection of 442 soundings from IBM cards to magnetic tape into standard format. The program also performs monotonicity tests on the density-altitude profiles of the soundings. Additional analyses have been performed with respect to certain thermistor temperature data corrections and improvements in the analysis of the correlation between atmospheric density and solar flux data.

I. INTRODUCTION

Models of the earth's atmosphere are continually being improved on the basis of analyses of the increasing inventory of observations. These extensions have been in the number of soundings, in the number of geographical regions of the earth represented by the soundings, in the increased altitude attained by the soundings, and in the quantity and quality of the data obtained from the soundings.

Owing to the greater frequency of measurements obtained via conventional radio-sonde techniques, the variability of the earth's atmosphere has now been rather well documented for altitudes below 30 km.

For altitudes above about 200 km there is a considerable volume of drag-acceleration data acquired from the measured orbits of artificial earth satellites. From these data atmospheric density can be deduced. As a result of the many satellite missions performed during the past decade, there has evolved the recognition that at these altitudes atmospheric parameters vary significantly with respect to time of day and time of year. In addition, atmospheric variations have been correlated with solar activity and geomagnetic index Several atmospheric models have evolved which reflect the variations. Accordingly, the multiple model concept is progressively replacing the earlier concept of a single average model atmosphere.

The altitude region between 30 and 200 km, and particularly between 100 and 200 km, is the least defined and the least understood with respect to the variability of the pertinent parameters The number of rocket observations of atmospheric properties below 100 km has increased considerably, but not nearly at the same rate as satellite data above 200 km. Rocket observations above 100 km have been relatively rare. Moreover, rocket samples are singular events and do not provide a continuous rate of data input. A major limitation of these samples is that the observations have been scattered in both time and geographic location.

For the purpose of constructing atmospheric models, the atmosphere is customarily divided into two basic regimes one below 120 km where mixing prevails, and the other above 120 km where diffusive separation prevails. Preliminary models, necessarily based on rather limited data, have been developed (Ref. 1) which attempt to reflect seasonal and latitudinal variations below 120 km. These models suggest seasonal variability to be minimum at tropical latitudes and to increase to maximum at sub-polar latitudes. The models also suggest that an

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isopycnic region prevails at about 90 km which displays a density that is estimated to be about 14 percent greater than that of the 1962 United States Standard Atmosphere for that altitude.

Owing to the current stringent requirements of various flight and space operations, a rather detailed knowledge of the diurnal, seasonal, and latitudinal variation in upper atmospheric properties is becoming increasingly important. However, there remains considerable work to be done to adequately define the detailed variability of the earth's atmosphere at these altitudes

Toward this goal, a continuing investigation of upper atmospheric models has been performed for a number of years (Refs 2, 3, and 4). A major accomplishment of these earlier programs has been the compilation of over four hundred rocket and optical-probe soundings taken during the period 1947 to early 1965 (Ref. 5). These data serve as an initial set of thermodynamic data suitable for subsequent preliminary statistical analysis The present document is an interim report on current work involving continued up-dating of data collection and further analysis of the data at hand with a view to the ultimate development of a more cogent interpretation of the variations in this important altitude regime.

The report is divided into four main topic areas each of which are treated in separate sections. Following the Introduction, Section II discusses the expansion of the original (442) sounding collection by the acquisition of new sounding data Also included in Section II is a specific discussion of Soviet rocket soundings For the most part, data from the Soviet flights, which constitute a significant percentage of the total, have not become available through the regular transmission channels of the World Data Center facilities, nor, with few exceptions, have the data been published by the Soviets In addition, certain problems and inconsistencies exist with respect to reported launch times.

Section III summarizes additional work performed on the original (442) sounding collection. The data, mostly in raw form, had until now existed in five different format types on punched cards. A computer program was written and run which reprocessed and transferred this data to magnetic tape into standard format for storage and to facilitate further analysis. A complete description of the program along with the new formats of the data and the sounding identification header cards are provided. Section III also discusses analyses performed with respect to certain thermistor temperature data corrections and improvement in analysis of the correlation between atmospheric density and solar flux data.

Section IV deals with the overall problem of data processing and analysis and merging the data on hand with the vast amount of Meteorological Rocket Network data.

II. DATA COLLECTION

A prerequisite for meaningful statistical analyses of the variability of the structure of the earth's atmosphere is the compilation of a comprehensive inventory of density, pressure, and temperature profile data on a global scale throughout the year and throughout the eleven-year solar cycle. Clearly, the validity of such analyses is highly dependent on the size of the data inventory.

Accordingly, an important part of the current program is the continuous collection from as many geographical locations as possible of reported atmospheric rocket soundings or rocket instrument releases to the extent that these data expand or correct an existing original set fo 442 soundings. Apart from the extensive sources of meteorological data to altitudes of about 50 or 60 km from the Meteorological Rocket Network, which is discussed later in Section IV, a primary source of sounding data is found in various scientific journals, books, technical reports, etc In addition to the results of the literature search, other unpublished data has been obtained through private correspondence with individual experimenters

This method is somewhat tedious and time consuming, but has produced in the past a remarkable and unique ensemble of data from diverse measurement techniques, launch sites, and altitudes. Previous efforts toward this end have produced the relatively comprehensive existing set, which consists of data from 442 atmospheric soundings, collected at GCA Technology Division under NASA contracts NASw-976, NASw-1225, NASw-1463, and NAS8-20098, as reported by R A. Minzner, et al. in GCA Technical Report, TR-67-10N, dated May, 1967. These data were obtained from 45 different sources collected from 17 fixed launch sites and a few shipboard launches.

Recent emphasis has been given to the assembly of a bibliography of additional rocket launchings which yielded thermodynamic data in the upper atmosphere. Data collected previously covered the period 1947 through early 1965 The current survey is designed not only to update these data with the results from subsequent rocket launches but also to supplement the original records with data that covered the same period but have only recently been published

Particularly valuable sources of listings of international rocket launches are the catalogues, supplements, and reports published by the World Data Center A, Rockets and Satellites, National Academy of Sciences. Recent summaries in this series identify the respective experimenters and their affiliations, facilitating direct correspondence with the individuals in order to obtain the measured data

Itemized requests for rocket sounding data were submitted to specific individual experimenters or project groups. About three-quarters of the data requests have thus far been answered Although the general response has been favorable, the results have been somewhat less than anticipated Data from a few of the flights were too poor to be meaningful. In another few cases, the World Data Center A reported misleading information about experiments contained on certain flights and, accordingly, for these, pertinent thermodynamic data were not obtained. Some of the replies failed to provide the tabulated data as requested and follow-on requests are required. Data from other flights are not as yet releasable. This data, however, and in some cases, data from future flights will be provided directly as soon as it becomes available

The itemized requests included, as far as possible, all soundings for which the principal experimenters are known. However, for a significant number of soundings that were launched between 1957 and 1963, the principal investigators were not recorded in the World Data Center A listings. This Center does not maintain in its archives the basic measured data from these specific flights nor does it have a record of the respective experimenters or project groups.

Efforts to obtain the data from these earlier flights are now being effected through the National Space Science Data Center. In addition, an attempt is being made to identify the pertinent experimenters by association of rocket flight number, experiment type, etc.

The results of the current survey of rocket launches are summarized in Table 1. This table provides a Chronological Bibliography of all rocket launches which may provide useful thermodynamic data for inclusion into the statistical study program. The listings give the date and time (GMT)*, site, experiment code (Table 2), principal investigator and/or rocket type and flight number for each sounding. There are a total of 1049 entries in this table, of which 575 are Soviet soundings.

It should be noted that the bibliography in Table 1 does not, in general, include the inventory of rocket launches available from the Meteorological Rocket Network (MRN), although some of these data may be found in the MRN publications, particularly launches during the period of the IGY.

*Times for many Soviet launches are uncertain, as discussed in Section IIB.

TABLE 1. CHRONOLOGICAL BIBLIOGRAPHY OF ROCKET SOUNDINGS 1957 - 1969

∇	11 JUL 57	0205	KAPUSTIN YAR	TPD	
∇	27 JUL 57	0220	KAPUSTIN YAR	TPD	
∇	14 AUG 57	0423	KAPUSTIN YAR	TPD	
	19 AUG 57	0313	KAPUSTIN YAR	TPD	
	25 AUG 57	0223	KAPUSTIN YAR	CPL	
	31 AUG 57	0530	KAPUSTIN YAR	CPL	
	9 SEP 57	1550	KAPUSTIN YAR	CPL	
∇	14 SEP 57	0300	KAPUSTIN YAR	TPD	
∇	20 SEP 57	0230	KAPUSTIN YAR	TPD	
∇	17 OCT 57	0300	KAPUSTIN YAR	TPD	
	16 DEC 57	0435	KAPUSTIN YAR	TPD	
∇	21 DEC 57	0440	KAPUSTIN YAR	TPD	
∇	21 DEC 57	0845	KAPUSTIN YAR	TPD	
∇	31 DEC 57	1910	66 26 S 92 49 E	TP	SHIP OB
	10 JAN 58	0727	KAPUSTIN YAR	TPD	
∇	19 JAN 58	0945	KAPUSTIN YAR	TPD	
	19 JAN 58	2321	KAPUSTIN YAR	TPD	
∇	21 JAN 58	0315	65 26 S 120 32 E	TP	SHIP OB
∇	2 FEB 58	0726	67 44 S 147 12 E	TP	SHIP OB
∇	10 FEB 58	0747	69 49 S 161 52 E	TP	SHIP OB
	11 FEB 58	0944	KAPUSTIN YAR	TPD	
∇	17 FEB 58	0306	48 01 S 171 06 E	TP	SHIP OB
	18 FEB 58	1431	KAPUSTIN YAR	TPD	
	21 FEB 58	0842	KAPUSTIN YAR	CPL	
	26 FEB 58	0435	KAPUSTIN YAR	TPD	
∇	9 MAR 58	2330	38 53 S 142 08 E	T	SHIP OB
∇	15 MAR 58	1154	43 15 S 160 15 E	TP	SHIP OB
∇	17 MAR 58	0300	HEISS ISLAND		
∇	18 MAR 58	1029	47 53 S 166 24 E	P	SHIP OB
	20 MAR 58	2145	KAPUSTIN YAR	TPD	
∇	28 MAR 58	0000	67 26 S 165 40 E	P	SHIP OB
∇	31 MAR 58	2141	67 17 S 173 30 E	P	SHIP OB
∇	1 APR 58	1841	67 26 S 180 00 W	TP	SHIP OB
∇	2 APR 58	1445	69 19 S 164 55 W	TP	SHIP OB
∇	20 APR 58	1540	KAPUSTIN YAR	TPD	
∇	21 APR 58	1548	66 22 S 128 03 W	TP	SHIP OB
∇	23 APR 58	1624	65 41 S 109 46 W	TP	SHIP OB
∇	24 APR 58	1658	64 59 S 109 10 W	TP	SHIP OB
∇	26 APR 58	1659	60 28 S 109 16 W	TP	SHIP OB
∇	28 APR 58	1700	55 00 S 109 37 W	TP	SHIP OB
∇	30 APR 58	1700	49 12 S 109 20 W	TP	SHIP OB
∇	3 MAY 58	1742	39 52 S 109 17 W	TP	SHIP OB
∇	5 MAY 58	1845	32 46 S 109 18 W	TP	SHIP OB
∇	7 MAY 58	1734	27 37 S 109 25 W	TP	SHIP OB
∇	18 MAY 58	0156	KAPUSTIN YAR	TPD	
	31 MAY 58	0145	KAPUSTIN YAR	TPD	
∇	24 JUN 58	0145	KAPUSTIN YAR	TPD	
∇	29 JUN 58	0130	KAPUSTIN YAR	TPD	
∇	10 JUL 58	1553	32 10 S 47 50 W	TP	SHIP OB
∇	12 JUL 58	1530	24 41 S 39 06 W	T	SHIP OB
∇	14 JUL 58	1630	16 13 S 33 02 W	TP	SHIP OB
	15 JUL 58	2145	KAPUSTIN YAR	TPD	
	16 JUL 58	0200	KAPUSTIN YAR	TPD	
∇	18 JUL 58	1630	03 45 N 23 15 W	TP	SHIP OB
∇	20 JUL 58	1649	14 01 N 25 26 W	TP	SHIP OB
∇	21 JUL 58	1630	18 45 N 24 39 W	P	SHIP OB
∇	27 JUL 58	0220	KAPUSTIN YAR	TPD	

TABLE 1 (Continued)

▽	31 JUL 58	0220	KAPUSTIN YAR	TPD	
▽	12 AUG 58	0310	KAPUSTIN YAR	TPD	
▽	12 AUG 58	0440	KAPUSTIN YAR	TPD	
	15 AUG 58	0440	KAPUSTIN YAR	TPD	
	6 SEP 58	0425	KAPUSTIN YAR	TPD	
	20 SEP 58	0535	KAPUSTIN YAR	TPD	
	22 SEP 58	0347	KAPUSTIN YAR	TPD	
	27 SEP 58	0348	KAPUSTIN YAR	TPD	
▽	1 OCT 58	0941	HEISS ISLAND		
	3 OCT 58	0332	KAPUSTIN YAR	TPD	
	8 OCT 58	0350	KAPUSTIN YAR	TPD	
	16 OCT 58	0400	KAPUSTIN YAR	TPD	
	17 OCT 58	0405	KAPUSTIN YAR	TPD	
	23 OCT 58	1331	KAPUSTIN YAR	TPD	
▽	28 OCT 58	2000	HEISS ISLAND		
▽	31 OCT 58	0900	HEISS ISLAND		
▽	14 NOV 58	0800	HEISS ISLAND		
▽	18 NOV 58	0845	HEISS ISLAND		
	23 DEC 58	0303	MICHIKAWA	TW	KAPPA-VI-TW-5
	27 DEC 58	0950	KAPUSTIN YAR	TPD	
	3 JAN 59	0000	HEISS ISLAND	TP	
▽	12 MAR 59	1109	KAPUSTIN YAR	TP	
▽	12 MAR 59	1540	KAPUSTIN YAR	TPW	
	18 MAR 59	0305	MICHIKAWA	TW	KAPPA-VI-TW-6
	20 MAR 59	0312	MICHIKAWA	TW	KAPPA-VI-TW-7
	23 APR 59		65 41 S 109 46 W		BOROVIKOV A. M.
	25 APR 59		60 15 S 109 43 W		BOROVIKOV A. M.
	27 APR 59		54 49 S 109 40 W		BOROVIKOV A. M.
	29 APR 59		49 23 S 109 37 W		BOROVIKOV A. M.
	1 MAY 59		43 57 S 109 34 W		BOROVIKOV A. M.
	3 MAY 59		38 31 S 109 31 W		BOROVIKOV A. M.
▽	5 MAY 59	1200	HEISS ISLAND	TP	
	5 MAY 59		33 05 S 109 28 W		BOROVIKOV A. M.
	7 MAY 59		27 37 S 109 25 W		BOROVIKOV A. M.
	12 MAY 59	1139	HOLLOMAN	AC	AA3.200C
	22 MAY 59	1115	HOLLOMAN	AC	AA3.201C
	27 MAY 59	0451	WHITE SANDS	UAP	AA6.161C
	27 MAY 59	1950	WHITE SANDS	UAP	AA6.162C
	10 JUL 59		32 S 46 W		BOROVIKOV A. M.
	12 JUL 59		23 S 42 30 W		BOROVIKOV A. M.
	14 JUL 59		14 S 39 W		BOROVIKOV A. M.
	16 JUL 59		05 S 35 30 W		BOROVIKOV A. M.
	18 JUL 59		04 N 32 W		BOROVIKOV A. M.
	20 JUL 59		13 N 28 30 W		BOROVIKOV A. M.
	22 JUL 59		22 N 25 W		BOROVIKOV A. M.
	24 JUL 59		31 N 21 30 W		BOROVIKOV A. M.
	26 JUL 59		40 N 18 W		BOROVIKOV A. M.
	17 AUG 59	0918	WALLOPS ISLAND	UAP	NASA3.13
	7 SEP 59	1245	HEISS ISLAND	TP	
	10 SEP 59	0020	HEISS ISLAND	TP	
	13 SEP 59	2100	HEISS ISLAND	TPW	
	29 SEP 59	1059	EGLIN FIELD	AC	AA6.203C
	30 SEP 59	1057	EGLIN FIELD	AC	AA6.204C
	1 OCT 59	1049	EGLIN FIELD	AC	AA6.210C
	2 OCT 59	1100	EGLIN FIELD	AC	AA6.211C
	3 OCT 59	1103	EGLIN FIELD	AC	AA6.202C
	9 OCT 59	0840	EGLIN FIELD	AC	AA6.209C

TABLE 1 (Continued)

	9 OCT 59	1117	EGLIN FIELD	AC	AA6.213C
	12 OCT 59	0900	EGLIN FIELD	AC	AA6.208C
	12 OCT 59	1112	EGLIN FIELD	AC	AA6.206C
	13 OCT 59	1117	EGLIN FIELD	AC	AA6.214C
	15 OCT 59	1105	EGLIN FIELD	AC	AA6.207C
	16 OCT 59	1117	EGLIN FIELD	AC	AA6.215C
▽	20 OCT 59	1315	KAPUSTIN YAR	TPW	
▽	22 OCT 59	0356	KAPUSTIN YAR	TPW	
▽	22 OCT 59	0955	KAPUSTIN YAR	TPW	
▽	22 OCT 59	2100	HEISS ISLAND	TP	
	18 NOV 59	2217	WALLOPS ISLAND	UAP	NASA3.15
	19 NOV 59	1036	FORT CHURCHILL	UAP	AA6.163C
	20 NOV 59	1816	FORT CHURCHILL	UAP	AA6.164C
▽	3 DEC 59	0800	KAPUSTIN YAR	TPW	
▽	3 DEC 59	1004	KAPUSTIN YAR	TPW	
▽	3 DEC 59	1228	KAPUSTIN YAR	TPW	
	4 DEC 59	0507	KAPUSTIN YAR	PW	
▽	24 DEC 59	2100	HEISS ISLAND	TP	
	7 JAN 60	2100	HEISS ISLAND	TP	
	18 JAN 60	2100	HEISS ISLAND	TP	
	20 JAN 60	2145	36 20 N 176 24 E	TPW	
	21 JAN 60	1031	36 43 N 175 55 E	PW	
	21 JAN 60	2100	HEISS ISLAND	TP	
	24 JAN 60	0700	36 41 N 175 44 E	TPW	
	26 JAN 60	2100	HEISS ISLAND	TP	
	27 JAN 60	2301	30 50 N 179 53 E	TP	
	28 JAN 60	2100	HEISS ISLAND	TP	
	29 JAN 60	0921	29 08 N 169 13 E	TPW	
	30 JAN 60	1154	26 00 N 169 27 E	TPW	
	30 JAN 60	2100	HEISS ISLAND	TP	
	31 JAN 60	1104	25 05 N 168 59 E	TW	
	1 FEB 60	1030	23 03 N 166 57 E	TPW	
	1 FEB 60	2100	HEISS ISLAND	TW	
	2 FEB 60	1038	20 29 N 163 21 E	TPW	
	3 FEB 60	1121	18 05 N 160 07 E	TPW	
	3 FEB 60	2100	HEISS ISLAND	TPW	
	4 FEB 60	1100	16 06 N 157 12 E	TPW	
	5 FEB 60	1100	14 25 N 155 13 E	TPW	
	6 FEB 60	1100	13 55 N 154 23 E	TPW	
	7 FEB 60	1104	11 41 N 151 40 E	TPW	
	8 FEB 60	1102	09 57 N 149 52 E	TPW	
	9 FEB 60	1107	10 26 N 149 32 E	TPW	
	9 FEB 60	2100	HEISS ISLAND	TP	
	10 FEB 60	1200	14 05 N 149 13 E	TP	
	11 FEB 60	1100	14 29 N 148 58 E	TPW	
	13 FEB 60	0855	19 28 N 148 06 E	TP	
	27 FEB 60	0648	FORT CHURCHILL	UAP	AA4.360C
	27 FEB 60	2100	HEISS ISLAND	TPW	
	2 MAR 60	2100	HEISS ISLAND	TPW	
	9 MAR 60	2100	HEISS ISLAND	TPW	
	27 MAR 60	2100	HEISS ISLAND	TPW	
	17 APR 60	0000	HEISS ISLAND	TPW	
	26 APR 60	0000	HEISS ISLAND	TPW	
	29 APR 60	1547	WALLOPS ISLAND	AC	NASA4.09
	5 MAY 60	0000	HEISS ISLAND	TPW	
	16 MAY 60	0000	HEISS ISLAND	TP	
	25 MAY 60	0048	WALLOPS ISLAND	UAP	NASA3.24

TABLE 1 (Continued)

26	MAY	60	1825	KAPUSTIN YAR	TP	
27	MAY	60	0000	HEISS ISLAND	TPW	
8	JUN	60	0000	HEISS ISLAND	TPW	
8	JUN	60	0010	KAPUSTIN YAR	PW	
9	JUN	60	0420	45 46 N 32 21 E	TP	
9	JUN	60	1555	45 55 N 32 20 E	TP	
10	JUN	60	0400	45 46 N 32 21 E	TPW	
10	JUN	60	2000	45 46 N 32 23 E	TPW	
16	JUN	60	0529	WALLOPS ISLAND	UAP	NASA10.03
22	JUN	60	0000	KAPUSTIN YAR	TPW	
22	JUN	60	0115	KAPUSTIN YAR	TW	
27	JUN	60	1315	WHITE SANDS	UAP	NRL-58
27	JUN	60	2010	EGLIN FIELD	UAP	AA8.242
28	JUN	60	0610	EGLIN FIELD	UAP	AA8.243
29	JUN	60	0004	KAPUSTIN YAR	TPW	
30	JUN	60	0028	KAPUSTIN YAR	TPW	
30	JUN	60	0137	KAPUSTIN YAR	TW	
1	JUL	60	0013	KAPUSTIN YAR	TPW	
12	JUL	60	1100	42 21 N 179 43 E	TP	
15	JUL	60	1100	42 11 N 179 34 E	TPW	
18	JUL	60	1100	41 58 N 179 53 8 E	TP	
21	JUL	60	1100	41 54 N 178 52 E	PW	
24	JUL	60	1100	42 13 N 179 25 3 E	TPW	
27	JUL	60	1100	42 04 N 179 42 8 E	TPW	
28	JUL	60	0021	KAPUSTIN YAR	TPW	
29	JUL	60	1100	39 41 N 180 00 E	TP	
30	JUL	60	1100	35 41 1 N 180 00 E	TPW	
31	JUL	60	1100	31 58 6 N 180 00 E	TPW	
1	AUG	60	1100	28 16 2 N 180 00 E	PW	
2	AUG	60	1100	24 40 N 180 00 E	TPW	
3	AUG	60	0008	KAPUSTIN YAR	TPW	
4	AUG	60	0000	KAPUSTIN YAR	TPW	
5	AUG	60	0000	KAPUSTIN YAR	TPW	
5	AUG	60	1100	13 31 3 N 180 00 E	TW	
6	AUG	60	0000	KAPUSTIN YAR	TPW	
6	AUG	60	1100	09 53 N 180 00 E	TPW	
7	AUG	60	0000	KAPUSTIN YAR	TPW	
8	AUG	60	0000	KAPUSTIN YAR	TPW	
9	AUG	60	0000	KAPUSTIN YAR	TPW	
9	AUG	60	1100	01 17 S 179 00 E	PW	
12	AUG	60	1100	05 16 4 N 179 57 E	TPW	
14	AUG	60	1100	12 11 5 N 177 21 E	TPW	
15	AUG	60	2300	13 24 N 175 24 E	TPW	
19	AUG	60	0000	HEISS ISLAND	TPW	
25	AUG	60	0104	EGLIN FIELD	UAP	AA8.244
1	SEP	60	0000	HEISS ISLAND	TPW	
12	SEP	60	0000	HEISS ISLAND	TPW	
16	SEP	60	0000	HEISS ISLAND	TP	
16	SEP	60	0015	KAPUSTIN YAR	TP	
17	SEP	60	0250	MICHIKAWA	T	S15 K-6(TW-8)
20	SEP	60	0000	HEISS ISLAND	TPW	
21	SEP	60	0100	KAPUSTIN YAR	TPW	
29	SEP	60	0246	MICHIKAWA	T	S18 K-6H(TW-9)
10	OCT	60	0000	HEISS ISLAND	TPW	
14	OCT	60	0000	HEISS ISLAND	TPW	
14	OCT	60	0000	KAPUSTIN YAR	TP	
18	OCT	60	0000	HEISS ISLAND	PW	

25 OCT 60	0010	KAPUSTIN YAR	TW	
26 OCT 60	0000	HEISS ISLAND	PW	
29 OCT 60	0000	HEISS ISLAND	TPW	
29 OCT 60	0014	KAPUSTIN YAR	TP	
30 OCT 60	0000	HEISS ISLAND	TPW	
30 OCT 60	0343	KAPUSTIN YAR	TP	
5 NOV 60	0000	HEISS ISLAND	PW	
8 NOV 60	1405	41 49 N 179 12 E	TPW	
10 NOV 60	0000	HEISS ISLAND	PW	
14 NOV 60	0000	HEISS ISLAND	TW	
15 NOV 60	1100	42 00 N 179 30 E	TPW	
15 NOV 60	1641	WALLOPS ISLAND	AC	NASA4.14
17 NOV 60	0000	HEISS ISLAND	PW	
17 NOV 60	1105	42 00 N 179 30 E	TPW	
19 NOV 60	1100	42 00 N 179 30 E	TP	
21 NOV 60	1107	42 00 N 179 30 E	TPW	
26 NOV 60	1100	39 00 N 179 30 E	TPW	
28 NOV 60	1142	39 00 N 179 30 E	TPW	
29 NOV 60	0001	KAPUSTIN YAR	TP	
30 NOV 60	1148	39 00 N 179 30 E	TPW	
2 DEC 60	1100	33 51 N 179 50 E	PW	
4 DEC 60	1100	27 07 N 179 50 E	PW	
5 DEC 60	1100	23 32 N 179 50 E	TPW	
6 DEC 60	1100	19 55 N 179 50 E	TP	
8 DEC 60	1100	12 53 N 179 50 E	TPW	
9 DEC 60	1055	09 42 N 179 50 E	TPW	
9 DEC 60	1130	WALLOPS ISLAND	UAP	NASA10.12
10 DEC 60	2230	WALLOPS ISLAND	UAP	NASA8.05
13 DEC 60	0100	HEISS ISLAND	TPW	
13 DEC 60	1330	04 26 S 179 50 E	TPW	
14 DEC 60	1652	WALLOPS ISLAND	UAP	NASA10.06
15 DEC 60	0119	KAPUSTIN YAR	TP	
16 DEC 60	1100	12 01 S 179 48 5 E	TPW	
20 DEC 60	0000	HEISS ISLAND	TPW	
21 DEC 60	0000	HEISS ISLAND	PW	
8 JAN 61	1044	39 16 N 179 51 8 W	TPW	
9 JAN 61	1052	35 48 N 179 40 W	TPW	
10 JAN 61	1104	32 21 8 N 179 55 2 W	TPW	
11 JAN 61	1056	29 07 2 N 179 59 5 W	TPW	
15 JAN 61	1052	14 20 5 N 179 59 5 W	TPW	
18 JAN 61	1100	03 35 4 N 179 55 W	PW	
20 JAN 61	1103	01 09 8 S 179 55 2 W	PW	
23 JAN 61	1100	10 59 6 S 179 44 5 W	PW	
24 JAN 61	1103	14 06 S 179 54 3 W	TPW	
25 JAN 61	1800	HEISS ISLAND	TPW	
26 JAN 61	1800	HEISS ISLAND	TPW	
27 JAN 61	1800	HEISS ISLAND	TPW	
14 FEB 61	1800	HEISS ISLAND	TW	
14 FEB 61	1803	KAPUSTIN YAR	TP	
15 FEB 61	0827	KAPUSTIN YAR	TPW	
15 FEB 61	0953	KAPUSTIN YAR	TPW	
21 FEB 61	1200	HEISS ISLAND	TPW	
24 FEB 61	0019	EGLIN FIELD	UAP	AA6.170
28 FEB 61	1200	HEISS ISLAND	TP	
19 APR 61	0936	WALLOPS ISLAND	UAP	NASA3.05
20 APR 61	2312	WALLOPS ISLAND	UAP	NASA3.06
21 APR 61	0939	WALLOPS ISLAND	UAP	NASA3.08

TABLE 1 (Continued)

24 APR 61	0253	WOOMERA	DS	HAT-201
27 APR 61	2300	08 06 S 179 53 E	TP	
29 APR 61	1100	02 45 S 179 59 2 E	TP	
3 MAY 61	2305	13 16 9 N 179 58 E	TPW	
8 MAY 61	1102	28 01 N 179 49 E	TPW	
9 MAY 61	1153	WALLOPS ISLAND	UAP	NASA10.29
12 MAY 61	0830	42 00 N 179 48 E	TP	
10 JUN 61	1314	43 19 5 N 178 47 7 E	TPW	
10 JUN 61	2255	43 11 N 179 48 7 E	TPW	
11 JUN 61	1050	41 26 2 N 180 00 E	TPW	
12 JUN 61	1110	38 01 N 179 52 5 E	TPW	
13 JUN 61	1100	34 47 N 179 59 E	TP	
14 JUN 61	1050	31 59 N 179 59 6 E	TPW	
16 JUN 61	1100	23 46 N 179 50 3 E	PW	
16 JUN 61	2100	HEISS ISLAND	TW	
18 JUN 61	0455	MICHIKAWA	P	S21 E-4(ROCKOON)
18 JUN 61	1100	15 56 9 N 180 00 E	TPW	
18 JUN 61	2100	HEISS ISLAND	TPW	
19 JUN 61	1100	12 35 2 N 180 00 E	TPW	
20 JUN 61	1050	09 16 N 179 56 E	TPW	
21 JUN 61	1100	05 44 3 N 179 58 6 E	PW	
22 JUN 61	2100	HEISS ISLAND	TW	
24 JUN 61	2100	HEISS ISLAND	TPW	
26 JUN 61	2200	HEISS ISLAND	TPW	
15 JUL 61	2100	HEISS ISLAND	TPW	
16 JUL 61	2100	HEISS ISLAND	TPW	
17 JUL 61	2100	HEISS ISLAND	TPW	
18 JUL 61	2100	HEISS ISLAND	TPW	
19 JUL 61	2100	HEISS ISLAND	TPW	
20 JUL 61	2100	HEISS ISLAND	TPW	
21 JUL 61	0242	MICHIKAWA	T	S22 K-8(ID-6TW-10)
21 JUL 61	2100	HEISS ISLAND	TPW	
22 JUL 61	2100	HEISS ISLAND	PW	
13 SEP 61	0932	WALLOPS ISLAND	UAP	NASA8.06CA
13 SEP 61	2353	WALLOPS ISLAND	UAP	NASA8.22CA
16 SEP 61	2339	WALLOPS ISLAND	UAP	NASA3.18CA
17 SEP 61	1003	WALLOPS ISLAND	UAP	NASA3.19CA
18 NOV 61	0630	WALLOPS ISLAND	AC	NASA10.72NA
5 DEC 61	1803	HEISS ISLAND	TP	
8 DEC 61	1800	HEISS ISLAND	TP	
9 DEC 61	0605	HAMMAGUIR	WT	CENTAURE-C07
11 DEC 61	1900	HEISS ISLAND	TP	
13 DEC 61	1800	HEISS ISLAND	TPW	
14 DEC 61	1029	WOOMERA	S	HAD-103
1 MAR 62	2323	WALLOPS ISLAND		NASA10.100CA
2 MAR 62	1047	WALLOPS ISLAND		NASA10.70GT
2 MAR 62	2105	WALLOPS ISLAND		NASA10.101CA
23 MAR 62	2344	WALLOPS ISLAND		NASA10.102CA
27 MAR 62	2348	WALLOPS ISLAND		NASA10.103CA
17 APR 62	0943	WALLOPS ISLAND		NASA3.20CA
31 MAY 62	0301	WOOMERA	DS	LONG TOM 14
7 JUN 62	0056	WALLOPS ISLAND		NASA3.21CA
8 JUN 62	0053	WALLOPS ISLAND		NASA10.44GA
26 JUN 62	0838	WOOMERA	S	HAD-108
7 AUG 62	2202	KRONOGARD		K62-2
8 AUG 62	1655	WALLOPS ISLAND		NASA4.60GT
27 AUG 62	0908	WOOMERA	S	HAD-107

	24 OCT 62	0946	WOOMERA	S	HAD-111
	7 NOV 62	1053	WALLOPS ISLAND		NASA14.16CA
∇	20 NOV 62	2141A	WALLOPS ISLAND		BRACE L. H.
∇	20 NOV 62	2141B	WALLOPS ISLAND		BRACE L. H.
	27 NOV 62	1017	WOOMERA	S	HAD-112
	30 NOV 62	1115	WALLOPS ISLAND		NASA14.17CA
	3 DEC 62	2320	EGLIN FIELD		NASA14.46AA
	4 DEC 62	0706	FORT CHURCHILL		NASA10.67GA
	4 DEC 62	1028	WOOMERA	S	HAD-113
	5 DEC 62	2216	WALLOPS ISLAND		NASA14.18CA
	30 JAN 63	1032	WOOMERA	S	HAD-115
	31 JAN 63	2100	HEISS ISLAND	TPW	
	3 FEB 63	2100	HEISS ISLAND	PW	
	12 FEB 63	2100	HEISS ISLAND	TP	
	20 FEB 63	2318	WALLOPS ISLAND		NASA14.35CA
	21 FEB 63	2316	WALLOPS ISLAND		NASA14.39CA
	10 MAR 63	2100	HEISS ISLAND	TW	
	12 MAR 63	0950	WOOMERA	S	HAD-116
	14 MAR 63	2345*	RESEARCH SHIPS	T	
	15 MAR 63	1725*	KAPUSTIN YAR	TPW	
	18 MAR 63	2350*	RESEARCH SHIPS	TPW	
	21 MAR 63	0930	WOOMERA	S	HAD-118
	21 MAR 63	1751*	KAPUSTIN YAR	TP	
	21 MAR 63	2150*	KAPUSTIN YAR	TP	
	23 MAR 63	2305*	RESEARCH SHIPS	TPW	
	26 MAR 63	0620*	KAPUSTIN YAR	TPW	
	26 MAR 63	0730*	KAPUSTIN YAR	TP	
	26 MAR 63	0950*	KAPUSTIN YAR	TPW	
	26 MAR 63	1150*	KAPUSTIN YAR	TPW	
	26 MAR 63	2258*	RESEARCH SHIPS	TP	
	28 MAR 63	0754	WALLOPS ISLAND		NASA14.08UA
	29 MAR 63	0752*	KAPUSTIN YAR	TPW	
	29 MAR 63	1019*	KAPUSTIN YAR	TPW	
	1 APR 63	2257*	RESEARCH SHIPS	TPW	
	2 APR 63	2258*	RESEARCH SHIPS	TPW	
	3 APR 63	2357*	RESEARCH SHIPS	TPW	
	4 APR 63	0640*	KAPUSTIN YAR	TW	
	4 APR 63	1625*	KAPUSTIN YAR	TW	
	4 APR 63	1735*	KAPUSTIN YAR	TPW	
	4 APR 63	2253*	RESEARCH SHIPS	TPW	
	5 APR 63	2302*	RESEARCH SHIPS	TPW	
	6 APR 63	2356*	RESEARCH SHIPS	TP	
	12 APR 63	2305*	RESEARCH SHIPS	TPW	
	12 APR 63	2100	HEISS ISLAND	TPW	
	14 APR 63	2300*	RESEARCH SHIPS	TPW	
	16 APR 63	2300*	RESEARCH SHIPS	TPW	
∇	18 APR 63	2100A	WALLOPS ISLAND		BRACE L. H.
∇	18 APR 63	2100B	WALLOPS ISLAND		BRACE L. H.
	18 APR 63	2300*	RESEARCH SHIPS	TPW	
	20 APR 63	2303*	RESEARCH SHIPS	TPW	
	22 APR 63	2300*	RESEARCH SHIPS	TPW	
	22 MAY 63	0410	FORT CHURCHILL		NASA14.13CA
	22 MAY 63	0751	WALLOPS ISLAND		NASA14.14CA
	23 MAY 63	0413	WALLOPS ISLAND		NASA14.15CA
	24 MAY 63	0045	WALLOPS ISLAND		NASA14.40CA
	25 MAY 63	0047	WALLOPS ISLAND		NASA14.42CA
	31 MAY 63	1604*	KAPUSTIN YAR	TP	

TABLE 1 (Continued)

	31 MAY 63	1822*	KAPUSTIN YAR	TP	
	31 MAY 63	1940*	KAPUSTIN YAR	TPW	
	31 MAY 63	2110*	KAPUSTIN YAR	TPW	
	4 JUN 63	1543*	KAPUSTIN YAR	TPW	
	4 JUN 63	1718*	KAPUSTIN YAR	TPW	
	4 JUN 63	1840*	KAPUSTIN YAR	TP	
	12 JUN 63	0925*	KAPUSTIN YAR	TP	
	12 JUN 63	1034*	KAPUSTIN YAR	TPW	
	13 JUN 63	1205*	KAPUSTIN YAR	TP	
	18 JUN 63	1420*	KAPUSTIN YAR	TPW	
	19 JUN 63	0835*	KAPUSTIN YAR	TPW	
	19 JUN 63	1000*	KAPUSTIN YAR	TPW	
	20 JUN 63	1715*	KAPUSTIN YAR	TP	
	20 JUN 63	1817*	KAPUSTIN YAR	TPW	
	20 JUN 63	1915*	KAPUSTIN YAR	TP	
	20 JUN 63	2028*	KAPUSTIN YAR	TPW	
	20 JUN 63	2137*	KAPUSTIN YAR	TPW	
▽	20 JUL 63	2154A	WALLOPS ISLAND		BRACE L. H.
▽	20 JUL 63	2154B	WALLOPS ISLAND		BRACE L. H.
	27 JUL 63	0010	KRONOGARD		K63-1
	29 JUL 63	2328	KRONOGARD		K63-2
	1 AUG 63	2327	KRONOGARD		K63-3
	7 AUG 63	2229	KRONOGARD		K63-4
	10 SEP 63	0525*	KAPUSTIN YAR	TP	
	10 SEP 63	0640*	KAPUSTIN YAR	TPW	
	10 SEP 63	0850*	KAPUSTIN YAR	TPW	
	10 SEP 63	0935*	KAPUSTIN YAR	TP	
	12 SEP 63	0415*	KAPUSTIN YAR	TPW	
	12 SEP 63	0512*	KAPUSTIN YAR	TP	
	12 SEP 63	0610*	KAPUSTIN YAR	TPW	
	12 SEP 63	0713*	KAPUSTIN YAR	TPW	
	12 SEP 63	0900*	KAPUSTIN YAR	TP	
	12 SEP 63	1055*	KAPUSTIN YAR	TPW	
	12 SEP 63	1150*	KAPUSTIN YAR	TPW	
	16 SEP 63	2107*	KAPUSTIN YAR	TPW	
	16 SEP 63	2232*	KAPUSTIN YAR	TPW	
	16 SEP 63	2340*	KAPUSTIN YAR	TPW	
	17 SEP 63	0050*	KAPUSTIN YAR	TPW	
	17 SEP 63	0200*	KAPUSTIN YAR	TPW	
	17 SEP 63	0240*	KAPUSTIN YAR	TPW	
	17 SEP 63	0530*	KAPUSTIN YAR	TPW	
	17 SEP 63	1820*	KAPUSTIN YAR	TPW	
	26 NOV 63	1816	WALLOPS ISLAND		NASA14.10UA
	16 DEC 63	1132*	KAPUSTIN YAR	TPW	
	16 DEC 63	1324*	KAPUSTIN YAR	TPW	
	16 DEC 63	1923*	KAPUSTIN YAR	TPW	
	18 DEC 63	1959*	KAPUSTIN YAR	TPW	
	19 DEC 63	0920*	KAPUSTIN YAR	TPW	
	19 DEC 63	1020*	KAPUSTIN YAR	TPW	
	19 DEC 63	1439*	KAPUSTIN YAR	TPW	
	19 DEC 63	1610*	KAPUSTIN YAR	TPW	
	20 DEC 63	1720*	KAPUSTIN YAR	TPW	
	20 DEC 63	1925*	KAPUSTIN YAR	TPW	
	21 DEC 63	0907*	KAPUSTIN YAR	TPW	
	23 DEC 63	1615*	KAPUSTIN YAR	TPW	
	23 DEC 63	1721*	KAPUSTIN YAR	TPW	
	24 DEC 63	1717*	KAPUSTIN YAR	TP	

TABLE 1 (Continued)

	24 DEC 63	2131*	KAPUSTIN YAR	TPW	
	13 JAN 64	2100	HEISS ISLAND	TP	
	17 JAN 64	2200	HEISS ISLAND	TP	
∇	29 JAN 64	0309A	WALLOPS ISLAND		BRACE L. H.
∇	29 JAN 64	0309B	WALLOPS ISLAND		BRACE L. H.
	5 FEB 64	0440	FORT CHURCHILL	G	SMITH W. S.
	12 FEB 64	1016	WOOMERA	S	HAD 124
	19 MAR 64	1400	KAPUSTIN YAR	TPW	
	24 MAR 64	1736	KAPUSTIN YAR	TPW	
	8 APR 64	2008	HEISS ISLAND	TPW	
	13 APR 64	2008	HEISS ISLAND	TP	
∇	14 APR 64	0906	WOOMERA	S	HAD 129
∇	17 APR 64	2315	WALLOPS ISLAND	S	HANSEN W. H.
	18 APR 64	2000	HEISS ISLAND	TPW	
	19 APR 64	2000	HEISS ISLAND	TP	
	20 APR 64	2100	HEISS ISLAND	TPW	
	20 APR 64	2100	HEISS ISLAND	TP	
	22 APR 64	2200	HEISS ISLAND	TPW	
	22 APR 64	2230	HEISS ISLAND	TPW	
	24 APR 64	2100	HEISS ISLAND	TPW	
	26 APR 64	2008	HEISS ISLAND	TPW	
	27 APR 64	1732	KAPUSTIN YAR	PW	
	27 APR 64	2008	HEISS ISLAND	TPW	
	29 APR 64	1733	KAPUSTIN YAR	TPW	
	29 APR 64	2008	HEISS ISLAND	TPW	
	4 MAY 64	1729	KAPUSTIN YAR	TPW	
	6 MAY 64	1908	KAPUSTIN YAR	PW	
	12 MAY 64	1706	KAPUSTIN YAR	TPW	
∇	14 MAY 64	0837	WOOMERA	D	HAD 126
	14 MAY 64	1736	KAPUSTIN YAR	T	
	19 MAY 64	1702	KAPUSTIN YAR	TP	
	20 MAY 64	1700	KAPUSTIN YAR	TPW	
	21 MAY 64	1700	KAPUSTIN YAR	TPW	
	21 MAY 64	1805	KAPUSTIN YAR	TPW	
	7 JUN 64	2000	HEISS ISLAND	TPW	
	8 JUN 64	2000	HEISS ISLAND	TPW	
	10 JUN 64	2000	HEISS ISLAND	TPW	
∇	11 JUN 64	0831	WOOMERA	D	HAD 128
	12 JUN 64	2000	HEISS ISLAND	TPW	
	16 JUN 64	2000	HEISS ISLAND	TPW	
	17 JUN 64	2000	HEISS ISLAND	TP	
	18 JUN 64	2000	HEISS ISLAND	TPW	
	8 JUL 64	2000	HEISS ISLAND	TPW	
∇	9 JUL 64	0839	WOOMERA	D	HAD 141
	10 JUL 64	2100	HEISS ISLAND	TP	
	12 JUL 64	2000	HEISS ISLAND	TPW	
	13 JUL 64	2000	HEISS ISLAND	TPW	
	14 JUL 64	2000	HEISS ISLAND	TPW	
	17 JUL 64	2000	HEISS ISLAND	TPW	
	24 JUL 64	2000	HEISS ISLAND	TPW	
	28 JUL 64	2114	FORT CHURCHILL	I	CARIGNAN G. R.
	7 AUG 64	0015	KRONOGARD	G	SMITH W. S.
	14 AUG 64	2000	HEISS ISLAND	TPW	
	16 AUG 64	0113	KRONOGARD	G	SMITH W. S.
	16 AUG 64	2000	HEISS ISLAND	TPW	
	17 AUG 64	0049	KRONOGARD	G	SMITH W. S.
	18 AUG 64	1600	KAPUSTIN YAR	TP	

TABLE 1 (Continued)

∇	20 AUG 64	0902	WOOMERA	D	HAD 135
	20 AUG 64	1711	KAPUSTIN YAR	TPW	
	22 AUG 64	2000	HEISS ISLAND	TP	
	24 AUG 64	2100	HEISS ISLAND	TP	
	26 AUG 64	1809	KAPUSTIN YAR	TP	
	26 AUG 64	2000	HEISS ISLAND	TP	
	31 AUG 64	1731	KAPUSTIN YAR	TP	
	9 SEP 64	1705	KAPUSTIN YAR	TPW	
	12 SEP 64	2000	HEISS ISLAND	TP	
∇	17 SEP 64	0917	WOOMERA	D	HAD 144
	24 SEP 64	2000	HEISS ISLAND	TPW	
	12 OCT 64	2000	HEISS ISLAND	TP	
	14 OCT 64	2000	HEISS ISLAND	TP	
∇	15 OCT 64	0936	WOOMERA	S	HAD 146
	16 OCT 64	2000	HEISS ISLAND	TP	
	19 OCT 64	2100	HEISS ISLAND	P	
∇	21 OCT 64	2112	CARNARVON	S	HAD 148
	21 OCT 64	2140	HEISS ISLAND	P	
∇	22 OCT 64	1103	CARNARVON	S	HAD 140
	26 OCT 64	2000	HEISS ISLAND	P	
	28 OCT 64	2200	HEISS ISLAND	T	
	29 OCT 64	2000	HEISS ISLAND	TP	
	1 NOV 64	0615	BARKING SANDS	S	SMITH L. B.
	3 NOV 64	1738	WALLOPS ISLAND	G	THEON J. S.
	10 NOV 64	2326	EGLIN		SMIDDY M.
	11 NOV 64	0119	EGLIN		SMIDDY M.
∇	11 NOV 64	0959	WOOMERA	S	HAD 145
	12 NOV 64	0305	KAGOSHIMA	G	TAKAYA T.
	12 NOV 64	1000	WOOMERA	D	HAD 157
	15 NOV 64	2000	HEISS ISLAND	TP	
	16 NOV 64	1818	WALLOPS ISLAND		CARIGNAN G. R.
	18 NOV 64	2000	HEISS ISLAND	TP	
	7 JAN 65	0350	WALLOPS ISLAND	S	POTTER A. E.
	11 JAN 65	1215	HEISS ISLAND	TPW	
∇	12 JAN 65	1458	KWAJALEIN	D	SALAH J. E.
	13 JAN 65	1300	HEISS ISLAND	TPW	
	15 JAN 65	1200	HEISS ISLAND	TPW	
	18 JAN 65	1200	HEISS ISLAND	TPW	
	20 JAN 65	1200	HEISS ISLAND	TPW	
	20 JAN 65	1646	KAPUSTIN YAR	TPW	
	22 JAN 65	1230	HEISS ISLAND	TPW	
	22 JAN 65	1742	KAPUSTIN YAR	TPW	
	22 JAN 65	1842	KAPUSTIN YAR	TPW	
∇	27 JAN 65	2132	POINT BARROW	G	THEON J. S.
∇	27 JAN 65	2223	FORT CHURCHILL	G	SMITH W. S.
∇	27 JAN 65	2224	WALLOPS ISLAND	G	SMITH W. S.
∇	4 FEB 65	0445	POINT BARROW	G	THEON J. S.
∇	4 FEB 65	0510	WALLOPS ISLAND	G	SMITH W. S.
∇	4 FEB 65	1735	FORT CHURCHILL	G	SMITH W. S.
∇	8 FEB 65	2215	POINT BARROW	G	THEON J. S.
∇	8 FEB 65	2253	WALLOPS ISLAND	G	SMITH W. S.
∇	8 FEB 65	2300	FORT CHURCHILL	G	SMITH W. S.
	10 FEB 65	1200	HEISS ISLAND	TPW	
	16 FEB 65	1200	HEISS ISLAND	TPW	
	18 FEB 65	1200	HEISS ISLAND	TPW	
	19 FEB 65	1200	HEISS ISLAND	TPW	
∇	20 FEB 65	2210	37 48 N 75 20 W	T	FINGER, F. G.

	28 FEB 65	0915	EGLIN	S	ULWICK J.
	7 MAR 65	1965	03 55 N 82 46 W	TW	FINGER, F. G.
	8 MAR 65	1200	HEISS ISLAND	TPW	
	8 MAR 65	1517	KAPUSTIN YAR	TPW	
▽	8 MAR 65	1748	00 01 N 84 08 W	I	HORVATH J. J.
	10 MAR 65	0745	KAPUSTIN YAR	TPW	
	10 MAR 65	1205	HEISS ISLAND	TPW	
	10 MAR 65	1515	KAPUSTIN YAR	TPW	
	10 MAR 65	1715	KAPUSTIN YAR	TPW	
▽	10 MAR 65	2130	07 22 S 83 25 W	T	FINGER, F. G.
▽	11 MAR 65	0207	KAGOSHIMA	P	ARIZUMI N.
▽	11 MAR 65	0707	KAGOSHIMA	P	ARIZUMI N.
	11 MAR 65	0935	9 27 S 82 26 W	I	SCHAEFER E. J.
	11 MAR 65	2007	9 32 S 84 14 W	I	SCHAEFER E. J.
	12 MAR 65	1700	KAPUSTIN YAR	TPW	
	15 MAR 65	0745	KAPUSTIN YAR	TPW	
	15 MAR 65	1205	HEISS ISLAND	TPW	
	16 MAR 65	1944	12 55 S 78 00 W	TW	FINGER, F. G.
	17 MAR 65	1200	HEISS ISLAND	TPW	
	17 MAR 65	1400	KAPUSTIN YAR	TPW	
	17 MAR 65	2113	FORT CHURCHILL	I	GRENDA R. N.
	18 MAR 65	1205	HEISS ISLAND	TPW	
	18 MAR 65	1230	KAPUSTIN YAR	TPW	
▽	18 MAR 65	1952	12 49 S 77 58 W	TW	FINGER, F. G.
	19 MAR 65	1205	HEISS ISLAND	TPW	
	19 MAR 65	1441	KAPUSTIN YAR	TPW	
▽	19 MAR 65	1809	WALLOPS ISLAND		CARIGNAN G. R.
▽	20 MAR 65	0542	WALLOPS ISLAND		CARIGNAN G. R.
▽	21 MAR 65	1514	12 57 S 78 03 W	TW	FINGER, F. G.
▽	24 MAR 65	1913	11 34 S 78 23 W	TW	FINGER, F. G.
▽	27 MAR 65	1924	14 10 S 77 59 W	TW	FINGER, F. G.
▽	2 APR 65	1550	12 19 S 78 11 W	TW	FINGER, F. G.
▽	3 APR 65	0018	14 34 S 77 47 W	TW	FINGER, F. G.
▽	4 APR 65	1606	24 05 S 76 08 W	I	HORVATH J. J.
▽	5 APR 65	2119	30 52 S 75 00 W	T	FINGER, F. G.
▽	6 APR 65	1634	35 14 S 74 15 W	I	HORVATH J. J.
▽	9 APR 65	2026	44 23 S 77 47 W	I	HORVATH J. J.
▽	10 APR 65	1604	47 02 S 77 45 W	TW	FINGER, F. G.
▽	11 APR 65	0011	48 35 S 77 42 W	T	FINGER, F. G.
▽	11 APR 65	1533	52 11 S 77 49 W	TW	FINGER, F. G.
▽	13 APR 65	0405	60 00 S 78 00 W	I	HORVATH J. J.
▽	13 APR 65	1600	60 00 S 78 00 W	I	HORVATH J. J.
▽	13 APR 65	1956	59 52 S 77 58 W	TW	FINGER, F. G.
▽	14 APR 65	0038	59 46 S 77 50 W	TW	FINGER, F. G.
	14 APR 65	1215	HEISS ISLAND	TPW	
▽	15 APR 65	1045	WHITE SANDS	P	NIER A. O. C.
▽	15 APR 65	1600	52 35 S 78 20 W	I	HORVATH J. J.
▽	15 APR 65	1842	52 28 S 78 09 W	TW	FINGER, F. G.
	17 APR 65	0944	41 48 N 131 46 E	TPW	SHIP SHOKALSKY (8TH VOYAGE
	18 APR 65	1416	41 46 N 132 03 E	TPW	SHIP SHOKALSKY (8TH VOYAGE
	20 APR 65	1215	HEISS ISLAND	TPW	
	22 APR 65	1210	HEISS ISLAND	TPW	
	28 APR 65	1303	39 55 N 149 59 E	TPW	SHIP SHOKALSKY (8TH VOYAGE
▽	29 APR 65	1109	WOOMERA	G	SL-363
▽	29 APR 65	1225	WOOMERA	G	SL-364
▽	29 APR 65	1356	WOOMERA	G	SL-461
▽	29 APR 65	1606	WOOMERA	G	SL-462

TABLE 1 (Continued)

∇	29 APR 65	1706	WOOMERA		G	SL-463
	29 APR 65	1732	SONMIANI		G	NASA10.94IA
	30 APR 65	1030	40 07 N	161 04 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	30 APR 65	1200	31 00 N	150 07 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	30 APR 65	1417	40 03 N	156 02 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	1 MAY 65	1124	40 00 N	166 30 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	1 MAY 65	1159	26 28 N	150 00 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	2 MAY 65	1209	21 59 N	149 56 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	3 MAY 65	1211	17 20 N	150 00 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	4 MAY 65	1211	39 51 N	178 04 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	4 MAY 65	1507	12 14 N	149 57 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	5 MAY 65	0941	37 52 N	179 51 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	5 MAY 65	1305	08 16 N	149 35 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	6 MAY 65	0858	28 57 N	180 00 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	6 MAY 65	1159	04 09 N	150 00 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	7 MAY 65	0957	24 19 N	180 00 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	7 MAY 65	1222	00 00 S	150 09 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	8 MAY 65	1351	19 07 N	180 00 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	8 MAY 65	1200	00 01 S	154 30 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	9 MAY 65	0859	16 24 N	179 29 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	9 MAY 65	1200	00 09 S	157 39 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
∇	10 MAY 65	0730	CARNARVON		S	HAD 165
	10 MAY 65	0943	13 25 N	180 00 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
∇	10 MAY 65	1020	CARNARVON		S	HAD 164
	10 MAY 65	1242	00 00 S	162 10 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
∇	10 MAY 65	1320	CARNARVON		S	HAD 162
∇	10 MAY 65	1620	CARNARVON		S	HAD 158
∇	10 MAY 65	1920	CARNARVON		S	HAD-170
	10 MAY 65	2040	WOOMERA		S	SL-361
∇	11 MAY 65	0045	CARNARVON		S	HAD 154
∇	11 MAY 65	0310	CARNARVON		S	HAD 155
∇	11 MAY 65	0839	WOOMERA		S	HAD 160
	11 MAY 65	0959	10 10 N	180 00 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	11 MAY 65	1100	00 00 S	166 36 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	12 MAY 65	0905	05 57 N	180 00 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	12 MAY 65	1132	00 00 S	171 13 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	12 MAY 65	1215	HEISS ISLAND		TPW	
	13 MAY 65	1000	00 02 S	175 11 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	14 MAY 65	0859	00 44 S	180 00 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	15 MAY 65	0913	05 02 S	180 00 E	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	15 MAY 65	1041		179 59 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	16 MAY 65	1000	06 44 S	179 52 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	17 MAY 65	1000	11 20 S	179 27 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	18 MAY 65	1215	HEISS ISLAND		TPW	
	19 MAY 65	1215	HEISS ISLAND		TPW	
	20 MAY 65	1205	HEISS ISLAND		TPW	
∇	23 MAY 65	0202	ASCENSION ISL		I	HORVATH J. J.
∇	23 MAY 65	1400	ASCENSION ISL		I	HORVATH J. J.
∇	25 MAY 65	0735	CAPE KENNEDY		TPD	HANDY P. O.
	26 MAY 65	1058	19 50 S	164 41 W	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	27 MAY 65	1053	17 59 S	172 31 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	28 MAY 65	1042	18 06 S	167 50 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	28 MAY 65	2203	19 30 S	162 47 W	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	29 MAY 65	1058	17 37 S	163 45 E	TPW	SHIP SHOKALSKY (8TH VOYAGE)
	29 MAY 65	2206	19 41 S	158 25 W	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	30 MAY 65	2201	18 48 S	158 41 W	TPW	SHIP VOYEIKOV (12TH VOYAGE)
	30 MAY 65	2309	18 48 S	158 41 W	TPW	SHIP VOYEIKOV (12TH VOYAGE)

TABLE 1 (Continued)

	2 JUN 65	1445	19 13 S	153 05 W	TPW	SHIP VOYEIKOV (12TH VOYA
	3 JUN 65	1100	18 02 S	164 37 E	TPW	SHIP SHOKALSKY (8TH VOYA
▽	3 JUN 65	1104	KWAJALEIN		D	SALAH J. E.
	3 JUN 65	1232	15 04 S	150 09 W	TPW	SHIP VOYEIKOV (12TH VOYA
	4 JUN 65	1206	11 12 S	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
	5 JUN 65	1102	10 54 S	164 56 E	TPW	SHIP SHOKALSKY (8TH VOYA
	5 JUN 65	1155	06 57 S	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
	6 JUN 65	1100	06 27 S	165 00 E	TPW	SHIP SHOKALSKY (8TH VOYA
	6 JUN 65	1200	02 59 S	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
	7 JUN 65	1130	02 58 S	165 00 E	TPW	SHIP SHOKALSKY (8TH VOYA
	7 JUN 65	1158	00 55 N	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
	8 JUN 65	0831	WOOMERA		S	HAD 172
	8 JUN 65	1235	05 03 N	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
▽	9 JUN 65	0832	WOOMERA		S	HAD 171
	9 JUN 65	1102	05 37 N	165 00 E	TPW	SHIP SHOKALSKY (8TH VOYA
	9 JUN 65	1216	08 55 N	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
	10 JUN 65	1100	08 55 N	165 00 E	TPW	SHIP SHOKALSKY (8TH VOYA
	10 JUN 65	1201	13 00 N	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
▽	10 JUN 65	1328	KWAJALEIN		D	SALAH J. E.
	11 JUN 65	1100	13 18 N	165 00 E	TPW	SHIP SHOKALSKY (8TH VOYA
	11 JUN 65	1200	16 40 N	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
	12 JUN 65	1525	21 29 N	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
	13 JUN 65	1205	25 01 N	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
	13 JUN 65	1221	21 12 N	165 04 E	TPW	SHIP SHOKALSKY (8TH VOYA
	14 JUN 65	1100	25 09 N	165 01 E	TPW	SHIP SHOKALSKY (8TH VOYA
	14 JUN 65	1205	HEISS ISLAND		TPW	
	14 JUN 65	1205	HEISS ISLAND		TPW	
	14 JUN 65	1217	28 59 N	150 W	TPW	SHIP VOYEIKOV (12TH VOYA
	15 JUN 65	1127	33 00 N	150 02 W	TPW	SHIP VOYEIKOV (12TH VOYA
	15 JUN 65	1151	29 36 N	165 00 E	TPW	SHIP SHOKALSKY (8TH VOYA
	15 JUN 65	1225	HEISS ISLAND		TPW	
	15 JUN 65	1505	KAPUSTIN YAR		TPW	
	16 JUN 65	1153	33 04 N	165 01 E	TPW	SHIP SHOKALSKY (8TH VOYA
	16 JUN 65	1200	HEISS ISLAND		TPW	
	18 JUN 65	1210	HEISS ISLAND		TPW	
	18 JUN 65	1705	KAPUSTIN YAR		TPW	
	19 JUN 65	1251	35 49 [illegible]	170 00 W	TPW	SHIP VOYEIKOV (12TH VOYA
	21 JUN 65	1215	HEISS ISLAND		TPW	
	21 JUN 65	1500	KAPUSTIN YAR		TPW	
	23 JUN 65	1210	HEISS ISLAND		TPW	
	23 JUN 65	1210	HEISS ISLAND		TPW	
	25 JUN 65	1153	KAPUSTIN YAR		TPW	
▽	1 JUL 65	1021	KWAJALEIN		D	SALAH J. E.
	6 JUL 65	0930	KAPUSTIN YAR		TPW	
▽	7 JUL 65	0837	WOOMERA		S	HAD 174
▽	8 JUL 65	0226	KAGOSHIMA		P	ARIZUMI N.
	9 JUL 65	0815	KAPUSTIN YAR		TPW	
	13 JUL 65	0815	KAPUSTIN YAR		TPW	
	21 JUL 65	0802	KAPUSTIN YAR		TPW	
▽	21 JUL 65	1033	EGLIN		S	FAUCHER G
	22 JUL 65	0817	KAPUSTIN YAR		TPW	
	22 JUL 65	1315	HEISS ISLAND		TPW	
	23 JUL 65	0816	KAPUSTIN YAR		TPW	
▽	23 JUL 65	1705	WALLOPS ISLAND		GS	SMITH W. S.
	26 JUL 65	1215	HEISS ISLAND		TPW	
	27 JUL 65	0817	KAPUSTIN YAR		TPW	
	28 JUL 65	1215	HEISS ISLAND		TPW	

TABLE 1 (Continued)

▽	3 AUG 65	0852	WOOMERA	S	HAD 177
▽	7 AUG 65	1113	POINT BARROW	G	SMITH W. S.
▽	7 AUG 65	1200	FORT CHURCHILL	G	SMITH W. S.
▽	7 AUG 65	1830A	WALLOPS ISLAND	S	PETERSON J. W.
▽	7 AUG 65	1830B	WALLOPS ISLAND	S	PETERSON J. W.
▽	7 AUG 65	1939	POINT BARROW	G	SMITH W. S.
▽	7 AUG 65	1945	FORT CHURCHILL	G	SMITH W. S.
▽	7 AUG 65	2006	WALLOPS ISLAND	G	SMITH W. S.
▽	8 AUG 65	0340	WALLOPS ISLAND	G	SMITH W. S.
▽	8 AUG 65	0400	FORT CHURCHILL	G	SMITH W. S.
▽	8 AUG 65	0415	POINT BARROW	G	SMITH W. S.
▽	8 AUG 65	0840A	WALLOPS ISLAND	S	PETERSON J. W.
▽	8 AUG 65	0840B	WALLOPS ISLAND	S	PETERSON J. W.
▽	8 AUG 65	1003	FORT CHURCHILL	G	SMITH W. S.
▽	8 AUG 65	1015	WALLOPS ISLAND	G	SMITH W. S.
▽	9 AUG 65	1010	POINT BARROW	G	SMITH W. S.
	9 AUG 65	1112	POINT BARROW	G	SMITH W. S.
	12 AUG 65	0816	KAPUSTIN YAR	TPW	
	13 AUG 65	1215	HEISS ISLAND	TPW	
	17 AUG 65	1200	HEISS ISLAND	TPW	
	17 AUG 65	2355	LAPAN SPACE CENTER	G	SUBAGJO H.
	18 AUG 65	1215	HEISS ISLAND	TPW	
▽	26 AUG 65	1147	KWAJALEIN	D	SALAH J. E.
	8 SEP 65	0817	KAPUSTIN YAR	TPW	
	15 SEP 65	0817	KAPUSTIN YAR	TPW	
	19 SEP 65	1235	HEISS ISLAND	TPW	
	20 SEP 65	0327	KAPUSTIN YAR		
	20 SEP 65	1240	HEISS ISLAND	TPW	
	22 SEP 65	1013	KAPUSTIN YAR	TPW	
	22 SEP 65	1225	HEISS ISLAND	TPW	
	23 SEP 65	0916	KAPUSTIN YAR	TPW	
	24 SEP 65	1205	HEISS ISLAND	TPW	
▽	29 SEP 65	0700	KAGOSHIMA	P	ARIZUMI N.
▽	29 SEP 65	0200	KAGOSHIMA	P	ARIZUMI N.
	30 SEP 65	0420	SARDINIA	S	GROVES G. V.
	1 OCT 65	0357	KAPUSTIN YAR		
	1 OCT 65	0422	SARDINIA	S	GROVES G. V.
	6 OCT 65	1116	KAPUSTIN YAR	TPW	
▽	13 OCT 65	1601	POINT BARROW	G	SMITH W. S.
▽	13 OCT 65	1612	FORT CHURCHILL	G	SMITH W. S.
▽	13 OCT 65	1651	WALLOPS ISLAND	GS	SMITH W. S.
	19 OCT 65	1211	HEISS ISLAND	TPW	
▽	19 OCT 65	1730	POINT BARROW	G	SMITH W. S.
▽	19 OCT 65	1730	FORT CHURCHILL	G	SMITH W. S.
▽	19 OCT 65	2310	WALLOPS ISLAND	G	SMITH W. S.
	20 OCT 65	1200	HEISS ISLAND	TPW	
▽	23 OCT 65	1538	POINT BARROW	G	SMITH W. S.
▽	23 OCT 65	1614	WALLOPS ISLAND	G	SMITH W. S.
▽	23 OCT 65	1638	FORT CHURCHILL	G	SMITH W. S.
	27 OCT 65	1206	HEISS ISLAND	TPW	
▽	27 OCT 65	2342	POINT BARROW	G	SMITH W. S.
▽	27 OCT 65	2349	FORT CHURCHILL	G	SMITH W. S.
▽	28 OCT 65	0010	WALLOPS ISLAND	G	SMITH W. S.
	28 OCT 65	1107	KAPUSTIN YAR	TPW	
	29 OCT 65	0836	KAPUSTIN YAR	TPW	
	2 NOV 65	2000	EGLIN	S	FAIRE A. C.
	2 NOV 65	2250	SOUTH UIST	P	FRITH R.

TABLE 1 (Continued)

	3 NOV 65	0917	EGLIN	S	FAIRE A. C.
▽	9 NOV 65	1840A	FORT CHURCHILL	I	CARIGNAN G. R.
▽	9 NOV 65	1840B	FORT CHURCHILL	I	CARIGNAN G. R.
▽	9 NOV 65	2000A	FORT CHURCHILL	I	CARIGNAN G. R.
▽	9 NOV 65	2000B	FORT CHURCHILL	I	CARIGNAN G. R.
	16 NOV 65	1203	HEISS ISLAND	TPW	
	17 NOV 65	1200	HEISS ISLAND	TPW	
	18 NOV 65	1344	HEISS ISLAND	TPW	
	24 NOV 65	1202	HEISS ISLAND	TPW	
▽	29 NOV 65	1457	KWAJALEIN	D	SALAH J. E.
	9 DEC 65	2133	FORT CHURCHILL	S	FAIRE A.
	10 DEC 65	0600	FORT CHURCHILL	S	FAIRE A.
	11 DEC 65	0552	FORT CHURCHILL	S	FAIRE A.
	11 DEC 65	1955	FORT CHURCHILL	S	FAIRE A.
	13 DEC 65	1235	HEISS ISLAND	TPW	
	15 DEC 65	1210	HEISS ISLAND	TPW	
	17 DEC 65	1200	HEISS ISLAND	TPW	
	18 JAN 66	1110	KAGOSHIMA	P	ARIZUMI N.
▽	19 JAN 66	0200	KAGOSHIMA	P	ARIZUMI N.
▽	19 JAN 66	1030	KAGOSHIMA	P	ARIZUMI N.
	23 JAN 66	0742	FORT CHURCHILL	G	SMITH W. S.
▽	24 JAN 66	0542	FORT CHURCHILL	S	SMITH W. S.
▽	25 JAN 66	0152A	WALLOPS ISLAND	S	PETERSON J. W.
▽	25 JAN 66	0152B	WALLOPS ISLAND	S	PETERSON J. W.
	26 JAN 66	1745	BARKING SANDS	S	SMITH L. B.
	26 JAN 66	2350	BARKING SANDS	S	SMITH L. B.
▽	1 FEB 66	2012	POINT BARROW	G	SMITH W. S.
▽	1 FEB 66	2046	WALLOPS ISLAND	G	SMITH W. S.
▽	2 FEB 66	0202	FORT CHURCHILL	G	SMITH W. S.
▽	3 FEB 66	1831A	WALLOPS ISLAND	S	PETERSON J. W.
▽	3 FEB 66	1831B	WALLOPS ISLAND	S	PETERSON J. W.
▽	4 FEB 66	0154A	WALLOPS ISLAND	S	PETERSON J. W.
▽	4 FEB 66	0154B	WALLOPS ISLAND	S	PETERSON J. W.
	8 FEB 66	2000	WEST GEIRINISH	P	FRITH R.
	8 FEB 66	0300	BARKING SANDS	S	SMITH L. B.
▽	10 FEB 66	0709	FORT CHURCHILL	G	SMITH W. S.
▽	10 FEB 66	0748	WALLOPS ISLAND	G	SMITH W. S.
▽	10 FEB 66	0800	POINT BARROW	G	SMITH W. S.
▽	10 FEB 66	1800	FORT CHURCHILL	G	SMITH W. S.
▽	10 FEB 66	1841	WALLOPS ISLAND	G	SMITH W. S.
▽	10 FEB 66	2000	WEST GEIRINISH	P	FRITH R
	10 FEB 66	2030	POINT BARROW	G	SMITH W. S.
▽	10 FEB 66	2130	POINT BARROW	G	SMITH W. S.
	12 FEB 66	2000	WEST GEIRINISH	P	FRITH R.
	14 FEB 66	2000	WEST GEIRINISH	P	FRITH R.
	18 FEB 66	2000	WEST GEIRINISH	P	FRITH R.
	21 FEB 66	2200	WEST GEIRINISH	P	FRITH R.
	23 FEB 66	2000	WEST GEIRINISH	P	FRITH R.
	26 FEB 66	2000	WEST GEIRINISH	P	FRITH R.
▽	27 FEB 66	1652	ASCENSION ISL	E	HORVATH J. J.
	28 FEB 66	2000	WEST GEIRINISH	P	FRITH R.
	2 MAR 66	2000	WEST GEIRINISH	P	FRITH R.
	4 MAR 66	2000	WEST GEIRINISH	P	FRITH R.
	7 MAR 66	2000	WEST GEIRINISH	P	FRITH R.
	9 MAR 66	2000	WEST GEIRINISH	P	FRITH R.
	24 MAR 66	1531	SONMIANI	G	GROVES G. V.
▽	27 MAR 66	1712	SONMIANI	G	GROVES G. V.

TABLE 1 (Continued)

∇	14 APR 66	1509	WALLOPS ISLAND	T	EXAMETNET
	18 APR 66	2153	WEST GEIRINISH	P	FRITH R.
	21 APR 66	2203	WEST GEIRINISH	P	FRITH R.
∇	30 APR 66	0220	KAGOSHIMA	P	ARIZUMI N.
∇	30 APR 66	1040	KAGOSHIMA	P	ARIZUMI N.
∇	1 MAY 66	2210	POINT BARROW	G	SMITH W. S.
∇	2 MAY 66	0114	WALLOPS ISLAND	G	SMITH W. S.
∇	2 MAY 66	0119	NATAL	G	DEMENDONCA F.
∇	2 MAY 66	0153	WALLOPS ISLAND	T	EXAMETNET
∇	2 MAY 66	0155	NATAL	P	DEMENDONCA F.
∇	2 MAY 66	0200	KAGOSHIMA	P	ARIZUMI N.
∇	2 MAY 66	0232	FORT CHURCHILL	G	SMITH W. S.
∇	3 MAY 66	2201	POINT BARROW	G	SMITH W. S.
∇	4 MAY 66	0008	FORT CHURCHILL	G	SMITH W. S.
∇	4 MAY 66	0037	WALLOPS ISLAND	G	SMITH W. S.
∇	4 MAY 66	0120	NATAL	G	DEMENDONCA F.
∇	18 MAY 66	1550	NATAL	P	DEMENDONCA F.
∇	18 MAY 66	2022	CHAMICAL	P	LICHTENSTEIN E.
∇	1 JUN 66	1607	WALLOPS ISLAND	T	EXAMETNET
∇	1 JUN 66	1631	NATAL	P	DEMENDONCA F.
	3 JUN 66	0848	ABERPORTH	P	FRITH R.
	8 JUN 66	1515	BARKING SANDS	S	SMITH L. B.
	12 JUN 66	0918	BARKING SANDS	S	SMITH L. B.
∇	15 JUN 66	1532	NATAL	T	EXAMETNET
	16 JUN 66	0625	BARKING SANDS	S	SMITH L. B.
∇	17 JUN 66	0313	FORT CHURCHILL	G	SMITH W. S.
∇	17 JUN 66	0318	POINT BARROW	G	SMITH W. S.
∇	23 JUN 66	0635	FORT CHURCHILL	G	SMITH W. S.
∇	23 JUN 66	0752	POINT BARROW	G	SMITH W. S.
∇	29 JUN 66	1436	WALLOPS ISLAND	T	EXAMETNET
∇	29 JUN 66	1619	NATAL	T	EXAMETNET
	13 JUL 66	2244	CHAMICAL	P	LICHTENSTEIN E.
	14 JUL 66	0118	CHAMICAL	P	LICHTENSTEIN E.
	14 JUL 66	1517	CHAMICAL	P	LICHTENSTEIN E.
	1 AUG 66	2200	WHITE SANDS	S	AFCRL
	1 AUG 66	1900	WHITE SANDS	S	AFCRL
	6 AUG 66	0800	WHITE SANDS	S	AFCRL
	6 AUG 66	1100	WHITE SANDS	S	AFCRL
∇	7 AUG 66	0700	WALLOPS ISLAND	G	SMITH W. S.
∇	7 AUG 66	0705	NATAL	G	DEMENDONCA F.
∇	7 AUG 66	0904	FORT CHURCHILL	G	SMITH W. S.
∇	7 AUG 66	0949	FORT CHURCHILL	G	HORVATH J.
∇	7 AUG 66	1735	FORT CHURCHILL	G	SMITH W. S.
∇	7 AUG 66	2046	WALLOPS ISLAND	G	SMITH W. S.
∇	7 AUG 66	2326	NATAL	G	DEMENDONCA F.
∇	14 AUG 66	2035	POINT BARROW	G	SMITH W. S.
∇	15 AUG 66	0808	POINT BARROW	G	SMITH W. S.
	17 AUG 66	1630	CHAMICAL	P	LICHTENSTEIN E.
∇	26 AUG 66	1831	WALLOPS ISLAND	I	CARIGNAN G. R.
∇	26 AUG 66	1851	WALLOPS ISLAND	I	CARIGNAN G. R.
∇	26 AUG 66	1911	WALLOPS ISLAND	I	HORVATH J. J.
∇	28 AUG 66	0423	WALLOPS ISLAND	I	HORVATH J. J.
∇	28 AUG 66	0700	WALLOPS ISLAND	I	CARIGNAN G. R.
	8 SEP 66	1841	CHAMICAL	P	LICHTENSTEIN E.
	14 SEP 66	1915	CHAMICAL	P	LICHTENSTEIN E.
	21 SEP 66	1640	CHAMICAL	P	LICHTENSTEIN E.
	27 SEP 66	2037	WEST GEIRINISH	P	FRITH R.

TABLE 1 (Continued)

∇	30 SEP 66	1735	WALLOPS ISLAND	G	SMITH W. S.	
∇	30 SEP 66	2350	WALLOPS ISLAND	G	SMITH W. S.	
∇	1 OCT 66	0530	WALLOPS ISLAND	G	SMITH W. S.	
∇	1 OCT 66	0823	NATAL	G	DEMENDONCA F.	
∇	1 OCT 66	1128	WALLOPS ISLAND	G	SMITH W. S.	
∇	1 OCT 66	2039	NATAL	G	DEMENDONCA F.	
∇	2 OCT 66	0220	NATAL	G	DEMENDONCA F.	
∇	2 OCT 66	0820	NATAL	G	DEMENDONCA F.	
∇	2 OCT 66	1409	NATAL	G	DEMENDONCA F.	
	16 NOV 66	1530	TARTAGAL	P	LICHTENSTEIN E.	
	30 NOV 66	1145	WHITE SANDS		NIER A. O. C.	
	14 DEC 66	1407	CHAMICAL	P	LICHTENSTEIN E.	
	14 DEC 66	2025	CHAMICAL	P	LICHTENSTEIN E.	
	23 JAN 67	0701	WHITE SANDS	S	FAIRE A.	
	23 JAN 67	1000	WHITE SANDS	S	FAIRE A.	
	23 JAN 67	1300	WHITE SANDS	S	FAIRE A.	
	23 JAN 67	1925	WHITE SANDS	S	FAIRE A.	
	26 JAN 67	1845	WHITE SANDS	S	FAIRE A.	
	31 JAN 67	1911	WALLOPS ISLAND	G	SMITH W. S.	
	31 JAN 67	2317	FORT CHURCHILL	I	HORVATH J.	
	31 JAN 67	2348	POINT BARROW	G	SMITH W. S.	
	1 FEB 67	0141	POINT BARROW	G	SMITH W. S.	
	1 FEB 67	0346	FORT CHURCHILL	I	HORVATH J.	
	1 FEB 67	0418	POINT BARROW	G	SMITH W. S.	
	1 FEB 67	0538	FORT CHURCHILL	I	HORVATH J.	
	1 FEB 67	0741	POINT BARROW	G	SMITH W. S.	
	1 FEB 67	0826	FORT CHURCHILL	I	HORVATH J.	
	1 FEB 67	0956	POINT BARROW	G	SMITH W. S.	
	1 FEB 67	1158	FORT CHURCHILL	I	HORVATH J.	
	1 FEB 67	1426	POINT BARROW	G	SMITH W. S.	
	3 FEB 67	1752	WALLOPS ISLAND	G	SMITH W. S.	
	9 FEB 67	0616	FORT CHURCHILL	I	OBRIEN B. J.	
	16 FEB 67	0712	KIRUNA	G	CENTAURE CE-09	
∇	4 MAR 67	2104	EGLIN	S	FAUCHER G.	
∇	5 MAR 67	2104	EGLIN	S	FAUCHER G.	
	31 MAR 67	1719	WALLOPS ISLAND	G	SMITH W. S.	
	4 APR 67	0010	POINT BARROW	G	SMITH W. S.	
	11 APR 67	1715	WALLOPS ISLAND	G	SMITH W. S.	
	13 APR 67	0712	EGLIN	S	FAIRE A.	
	18 APR 67	1140	EGLIN	S	FAIRE A.	
	18 APR 67	2208	POINT BARROW	G	SMITH W. S.	
	20 APR 67	1732	WALLOPS ISLAND	G	SMITH W. S.	
	29 APR 67	1139	WALLOPS ISLAND	G	SMITH W. S.	
	30 APR 67	0140	POINT BARROW	G	SMITH W. S.	
	4 MAY 67	2007	WALLOPS ISLAND	G	SMITH W. S.	
	9 MAY 67	0720	POINT BARROW	G	SMITH W. S.	
	11 MAY 67	0825	WALLOPS ISLAND	G	SMITH W. S.	
	15 MAY 67	1140	POINT BARROW	G	SMITH W. S.	
	17 MAY 67	1615	CHAMICAL	P	LICHTENSTEIN E.	
	21 MAY 67	0700	BARKING SANDS	S	SMITH L. B.	
	1 JUN 67	0645	BARKING SANDS	S	SMITH L. B.	
	1 JUN 67	1030	BARKING SANDS	S	SMITH L. B.	
	14 JUN 67	1640	CHAMICAL	P	LICHTENSTEIN E.	
	24 JUN 67	0826	NATAL	G	SMITH W. S.	
	25 JUN 67	0834	NATAL,BRAZIL	G	SMITH W. S.	
	3 AUG 67		POINT BARROW	I	SMITH W. S.	
	5 AUG 67	0956	POINT BARROW	X	HORVATH J.	NASA-14.290

TABLE 1 (Continued)

5 AUG 67		POINT BARROW	I	SMITH W. S.
26 AUG 67	0635	EGLIN	X	MCISAAC J.
26 AUG 67		NATAL	G	SMITH W. S. NASA 14.241 GM
26 AUG 67		NATAL	G	SMITH W. S. NASA 14.242 GM
26 AUG 67		NATAL	G	SMITH W. S. NASA 14.243 GM
7 SEP 67	0600	EGLIN	X	FAIRE A.
13 SEP 67	2030	CHAMICAL	P	LICHENSTEIN E.
∇ 18 SEP 67	1910	WALLOPS ISLAND	I	CARIGNAN G. R.
13 OCT 67	2141	BARKING SANDS	X	KRUEGER A.
14 OCT 67	1120	NATAL	G	SMITH W. S.
15 OCT 67	1115	NATAL	G	SMITH W. S.
15 NOV 67	1557	CHAMICAL	P	LICHTENSTEIN E.
15 OCT 67	2315	NATAL	G	SMITH W. S.
29 NOV 67	0106	SONMIANI	X	RAHMATULLAH D.
29 NOV 67	0210	SONMIANI	X	RAHMATULLAH D.
12 DEC 67	2159	WALLOPS ISLAND	G	SMITH W. S.
13 DEC 67	0840	EGLIN	S	FAIRE A.
18 DEC 67		NATAL	G	SMITH W. S. NASA 10.246 GM
19 DEC 67		NATAL	G	SMITH W. S. NASA 10.247 GM
19 DEC 67		NATAL	G	SMITH W. S. NASA 10.250 GM
17 JAN 68	1725	CHAMICAL	X	LICHTENSTEIN E. EXAMETNET-28
1 FEB 68	0542	KIRUNA	G	GROVES V. G. CE-34
1 FEB 68	1853	WALLOPS ISLAND	G	SMITH W. S. NASA-10.264 GM
1 FEB 68	1900	FORT CHURCHILL	G	SMITH W. S. NASA-10.259 GM
1 FEB 68	1930	FORT CHURCHILL	G	SMITH W. S. NASA-10.260 GM
1 FEB 68	2015	FORT CHURCHILL	G	SMITH W. S. NASA-10.261 GM
1 FEB 68	2115	FORT CHURCHILL	G	SMITH W. S. NASA-10.262 GM
4 FEB 68	0533	KIRUNA	G	GROVES V. G. CE-35
5 FEB 68	2222	FORT CHURCHILL	G	SMITH W. S. NASA-10.263 GM
13 MAR 68	1528	CHAMICAL	P	LICHTENSTEIN E. EXAMETNET-30
17 MAR 68	0659	VEGA BAJA	I	HORVATH J. NASA-14.344 UM
17 MAR 68	1845	VEGA BAJA	I	HORVATH J. NASA-14.345 UM
18 MAR 68	0700	VEGA BAJA	I	HORVATH J. NASA-14.333 UM
24 MAR 68	1804	NATAL	G	SMITH W. S. NASA-10.270 GM
25 MAR 68	0600	NATAL	G	SMITH W. S. NASA-10.271 GM
25 MAR 68	1800	NATAL	G	SMITH W. S. NASA-10.272 GM
27 MAR 68	1558	CHAMICAL	P	LICHTENSTEIN E. EXAMETNET-32
10 APR 68	0210	CHAMICAL	P	LICHTENSTEIN E. EXAMETNET-34
1 MAY 68	2025	EGLIN	S	FAIRE A. AH 7.177
∇ 17 MAY 68	0900	KAUAI	D	FAUCHER G.
17 MAY 68	1825	11 07 N, 20 04 E	X	USSR, INST. EXPER. MET.
18 MAY 68	1805	10 52 N, 24 59 E	X	USSR, INST. EXPER. MET.
21 MAY 68	2009	23 07 N, 20 08 E	X	USSR, INST. EXPER. MET.
∇ 22 MAY 68	2100	KAUAI	D	FAUCHER G.
30 MAY 68	2039	WOOMERA	G	REES D. J. SL-761
31 MAY 68	0849	WOOMERA	G	REES D. J. SL-762
13 JUN 68	1820	MAR CHIQUITA	P	LICHTENSTEIN E. EXAMETNET 38
16 JUL 68	0145	MAR CHIQUITA	P	LICHTENSTEIN E. EXAMETNET 40
24 JUL 68	0046	WALLOPS ISLAND	G	SMITH W. S. NASA-10.265 GM
24 JUL 68	1019	WALLOPS ISLAND	G	SMITH W. S. NASA-10.258 GM
24 JUL 68	1830	WALLOPS ISLAND	X	DUBIN M. NASA-10.254 UA
24 JUL 68	2155	WALLOPS ISLAND	G	SMITH W. S. NASA-10.266 GM
8 AUG 68	1910	WALLOPS ISLAND	I	BRACE L. H. NASA-18.51 GA
8 AUG 68	1935	WALLOPS ISLAND	I	SMITH W. S. NASA-14.187 UM
9 AUG 68	0702	WALLOPS ISLAND	I	BRACE L. H. NASA-18.56 GA
9 AUG 68	0724	WALLOPS ISLAND	I	SMITH W. S. NASA-14.357 UM
14 AUG 68	2328	MAR CHIQUITA	P	LICHTENSTEIN E. EXAMETNET 42

TABLE 1 (Continued)

4 SEP 68	0104	EGLIN	S	FAIRE A.	AO-7.913-1
15 SEP 68	0200	KAGOSHIMA	P	ARIZUMI N.	MT-135-36
15 SEP 68	0518	KAGOSHIMA	P	ARIZUMI N.	MT-135-37
16 SEP 68	1712	WALLOPS ISLAND	G	SMITH W. S.	NASA-10.269
17 SEP 68	2003	POINT BARROW	G	SMITH W. S.	NASA-10.257
18 SEP 68	0730	FORT CHURCHILL	G	SMITH W. S.	NASA-10.282
15 OCT 68	0100	POINT BARROW	G	SMITH W. S.	NASA-10.287
15 OCT 68	0300	POINT BARROW	G	SMITH W. S.	NASA-10.288
15 OCT 68	1632	KIRUNA	G	GROVES G. V.	CE-39
15 OCT 68	2212	FORT CHURCHILL	G	SMITH W. S.	NASA-10.251
16 OCT 68	0012	FORT CHURCHILL	G	SMITH W. S.	NASA-10.252
1 NOV 68	0440	KIRUNA	G	GROVES G. V.	CE-50
19 NOV 68	1800	WALLOPS ISLAND	G	SMITH W. S.	NASA-10.293
19 NOV 68	2005	WALLOPS ISLAND	IS	HORVATH J.	NASA-14.386
20 NOV 68	1124	FORT CHURCHILL	G	SMITH W. S.	NASA-10.283
20 NOV 68	1324	FORT CHURCHILL	G	SMITH W. S.	NASA-10.284
22 NOV 68	0031	POINT BARROW	G	SMITH W. S.	NASA-10.289
22 NOV 68	0755	POINT BARROW	G	SMITH W. S.	NASA-10.290
7 DEC 68	0433	WOOMERA	X	BURROWS D. K.	SL-725
9 DEC 68	2255	EGLIN	X	HIGGINS J.	AF-7.660
13 DEC 68	0311	FORT CHURCHILL	G	SMITH W. S.	NASA-10.285
13 DEC 68	0459	POINT BARROW	G	SMITH W. S.	NASA-10.291
13 DEC 68	0511	FORT CHURCHILL	G	SMITH W. S.	NASA-10.286

TABLE 1 - COMMENTS

1. A ∇ symbol preceding a rocket launch listing indicates that the observational data for that flight have been acquired

2 For launches prior to 1968 where individual experimenters are not known, the rocket type and/or flight number has been included For 1968 launches both the experimenter and the rocket flight number are included if known.

3. As far as possible, unless otherwise indicated, all launch times are quoted as Universal Time (UT). If a * symbol follows a launch time, zone time is quoted, in which case it has not been possible to determine UT from the available data (See Section IIB)

4 The Kapustin Yar site for many of the Soviet launches is a tentative identification (See Section IIB)

5. Launch times are not available for Soviet ship launches in 1959 reported by Borovikov.

6 The quoted positions of certain Soviet ship launches in 1968 place the ship in North or Central Africa Position corrections are anticipated It is probable that the reported longitudes should be West rather than East as quoted

TABLE 2

EXPLANATION OF EXPERIMENT CODE CONTAINED IN CHRONOLOGICAL BIBLIOGRAPHY (TABLE 1)

Code	Experiment Type or Parameters Measured
AC	Atmospheric composition, not further specified
CPL	Complex investigation, not further specified
D	Density
E	Pitot static probe - pressure, temperature, density
G	Grenade - temperature, pressure, density
I	Instruments on rocket - pressure, temperature, density
P	Parachutes and instruments - temperature, density, or simply pressure
S	Falling sphere - temperature, density
T	Temperature
UAP	Upper atmospheric physics, not further specified
W	Winds, not applicable
X	Not specified

The Chronological Bibliography is in a constant state of revision and updating as more information regarding reported flights become available or as additional flights are announced The current listing, therefore should not be regarded as final but represents the best information to date, with respect to soundings in addition to those included in the original set of 442 soundings.

Of the 1049 rocket soundings listed in the bibliography, the measured data from 251 of these have been acquired Those soundings preceded by a ∇ symbol indicate the flights for which data have been acquired

It is anticipated that during subsequent phases of this study, measured data will be acquired for many of the older non-Soviet soundings, those for which principal experimenters had previously not been identified, as well as for the more recent soundings Furthermore, it is hoped that data from many of the Soviet soundings will become available. The USSR meteorological rocket data is discussed in the following section.

A Soviet Meteorological Rocket Data

Several hundred meteorological rocket soundings have been performed by Soviet investigators since the beginning of the IGY in 1957 These data, accordingly, represent a sizable fraction of the total international sounding data inventory Because of the relative importance of the Soviet data to the current study, emphasis was placed on organizing the soundings, resolving certain discrepancies and attempting to acquire the observational data. These matters are summarized in this section.

1 Acquisition of Soviet Data. The Chronological Bibliography discussed in the previous section contains nearly 600 pertinent Soviet soundings that were launched since 1957 Itemized summaries of Soviet rocket launches for 1962, 1966 and 1967 have not as yet been provided.

As part of a recent review of sounding tabulations of the World Data Center A, all of the included Soviet soundings were checked against meteorological rocket launch information provided by R. S Quiroz (Ref. 6) and also against various annual Soviet reports to COSPAR symposia and COSPAR Information Bulletins (Ref. 7) In Table 3 the results of this Soviet sounding survey are summarized and the present status of available measured data from these flights is provided.

A thorough survey of available Soviet meteorological and upper atmospheric literature since the IGY was conducted in search of any

TABLE 3

SUMMARY OF KNOWN USSR METEOROLOGICAL ROCKET LAUNCHES FROM 1957 TO 1968 AND STATUS OF DATA COLLECTION

Year	Source	Total	NUMBER OF LAUNCHES BY SITE HI	ML	SA	SB	SO	SP	SS	SV	SZ	Soundings Listed*	Notes
1957	Quiroz	12	3	8	-	-	1	-	-	-	-	-	a
	WDC-A	14	3	10	-	-	1	-	-	-	-	X	b,c,d,e
	(Data)	12	3	8	-	-	1	-	-	-	-	X	f,g,h,i
1958	Quiroz	59	23	10	-	-	26	-	-	-	-	-	a
	WDC-A	95	35	29	-	-	31	-	-	-	-	X	b,d,e,f
	(Data)	59	23	10	-	-	26	-	-	-	-	X	g,h,i,j
1959	Quiroz	24	13	11	-	-	-	-	-	-	-	-	a
	WDC-A	22	13	9	-	-	-	-	-	-	-	X	d,n,o,p
	Borovikov	-	-	-	17	-	-	-	-	-	-	X	q
	(Data)	17	9	8	-	-	-	-	-	-	-	X	g,k,r,s
1960	Quiroz	136	43	28	-	5	-	60	-	-	-	-	a
	WDC-A	117	37	24	-	4	-	52	-	-	-	X	d,n,o
	COSPAR	160	54	34	-	5	-	67	-	-	-	-	b,u,v
	(Data)	1	-	1	-	-	-	-	-	-	-	X	w
1961	Quiroz	68	34	4	-	-	-	30	-	-	-	-	a
	WDC-A	52	23	3	-	-	-	26	-	-	-	X	d,n,o
	COSPAR	111	53	15	-	-	-	43	-	-	-	-	b,v,x
	(Data)	-	-	-	-	-	-	-	-	-	-	X	k
1962	Quiroz	62	43	-	-	-	-	19	-	-	-	-	a
	COSPAR	70	51	-	-	-	-	19	-	-	-	-	b,v,y,z
	(Data)	-	-	-	-	-	-	-	-	-	-	-	A
1963	Quiroz	92	6	67	-	-	-	19	-	-	-	-	a
	COSPAR	86	5	65	-	-	-	16	-	-	-	X	d,n,B,C
	(Data)	1	-	1	-	-	-	-	-	-	-	X	k,D

*An "X" indicates that the date, time, and type of experiment are provided for each of the flights reported by that source

TABLE 3 (Continued)

Year	Source	Total	HI	ML	SA	SB	SO	SP	SS	SV	SZ	Soundings Listed	Notes
1964	Quiroz	83	65	18	-	-	-	-	-	-	-	-	a
	WDC-A	100	80	20	-	-	-	-	-	-	-	-	b,E
	COSPAR	61	44	17	-	-	-	-	-	-	-	X	d,n,C,F
	(Data)	-	-	-	-	-	-	-	-	-	-	X	k
1965	Quiroz	150	51	31	-	-	-	-	34	34	-	-	a
	WDC-A	150	51	31	-	-	-	-	34	34	-	-	b,E
	COSPAR	150	51	31	-	-	-	-	34	34	-	-	G
	Other	150	51	31	-	-	-	-	34	34	-	X	g,d,F,H,I
	(Data)	-	-	-	-	-	-	-	-	-	-	X	k,H
1966	Quiroz	-	-	-	-	-	-	-	-	-	-	-	J
	COSPAR	191	63	70	-	-	-	(-58)		-	-	-	b,E,K
	(Data)	-	-	-	-	-	-	-	-	-	-	-	A
1967	COSPAR	214	-	-	-	-	-	-	-	-	-	-	b,E,G,L
	(Data)	-	-	-	-	-	-	-	-	-	-	-	A
1968	WDC-A	-	(13)	(9)	-	-	-	-	-	-	(3)	X	J L,M
	(Data)	-	-	-	-	-	-	-	-	-	-	X	J,M

TABLE 3 - KEY TO SITES

HI - Heiss Island

ML - "Middle Latitudes" of USSR

SA - Unidentified Ship in the Antarctic and Atlantic Oceans

SB - Unidentified Ship in the Black Sea

SO - Ship Ob

SP - Unidentified Ship in the Pacific Ocean

SS - Ship Shokalskiy

SV - Ship Voveykov

SZ - Ship Professor Vize

TABLE 3 - NOTES

a. Quiroz' figures indicate successful flights. These may not be restricted to T, P, D experiments but may include soundings of winds data also.

b. Success or failure of flights not indicated.

c. In addition, WDC-A tabulation for 1957 lists 3 CPL - (complex) - identified flights from the "mid-latitudes" site. These flights are not meteorological soundings but geophysical flights. Of the variables T,P,D, only air pressure is obtained.

d. Figures for T,P,D experiments only.

e. WDC-A times listed for 1957-1958 identified as (probably) Moscow Time (MT) UT = MT - 3 hours.

f. Of the 3 Heiss Island soundings in 1957, 2 have been included with data in the original data set, Reference (5).

g. Data included in Reference (5) superseded by present data.

h. Data from Khvostikov, Reference (4). Times listed by Khvostikov for 1957-1959 data are identified as "zone time".

i. Times ("zone times" - ZT) given by Khvostikov for 1957-1958 Heiss Island data are consistent with the WDC-A (MT) times, i.e. ZT = MT + 1 hour. Then, UT = MT - 3 = ZT - 4 hours. Khvostikov's (ZT) times for the "mid-latitudes" site for 1957-1958 are <u>not</u> consistent with the WDC-A (MT) data According to Khvostikov's data, ZT = MT, ZT = MT + 1, and/or ZT = MT - 1 hour.

j. Data for Ship Ob has yet to be keypunched

k. Soundings listed in the Chronological Sort, First Quarterly Report under this Contract, contain errors or omissions Chronological Bibliography included in this document supersedes previous listings

l. In addition, WDC-A tabulations for 1958 list 10 CPL - identified rocket flights. See note (c).

m. Of the 23 Heiss Island soundings in 1958, 16 have been included with data in the original data set, Reference (5).

n. Figures indicate successful flights.

o. The 1959-1961 WDC-A tabulations list times as UT and local time (to nearest 15° meridian) - LT. For all the Heiss Island and "mid-latitudes" site data, UT = LT -4 hours.

p. Two errors were discovered in the WDC-A 1959 tabulations for Heiss Island, 11 February should read 12 February, and for the "mid-latitudes" site on 22 October, 0356 and 0756 hours should read 1356 and 1756 hours.

q. A. M Borovikov reference unknown Success of flight and reported times are uncertain

r. Of the 9 Heiss Island soundings in 1959, 6 have been included with data in the original data set, Reference (5).

s. Data from Khvostikov, Reference (4). Times listed by Khvostikov (ZT) for the 1959 Heiss Island data are consistent with the WDC-A listed times, i e. ZT = LT = UT + 4 hours See note (o).

t. Times (ZT) listed by Khvostikov for the 1959 "mid-latitudes" site data are not consistent with the WDC-A listed times, i e ZT = UT +2 hours Remains unexplained

u. Figures include "research" or geophysical rockets

v. COSPAR tabulations list number of rocket launches per month according to site. No individual listings are provided

w. One geophysical rocket data set, 9/22/60-ML, is included in the original data collection, Reference (5). This flight is not listed in the WDC-A tabulations. Reported launch time unconfirmed.

x. In addition to indicated meteorological rockets, 2 geophysical rockets and 2 rockets launched in conjunction with the 1960 solar eclipse are indicated from the "mid-latitudes" site.

y. From COSPAR, the 1962 Meteorological rocket launches were as follows

Month	HI	SP	Month	HI	SP	Month	HI	SP
Jan	0	13	May	6	0	Sep	0	0
Feb	3	6	Jun	0	0	Oct	0	0
Mar	2	0	Jul	0	0	Nov	12	0
Apr	4	0	Aug	12	0	Dec	12	0

z. In addition to indicated meteorological rockets, 1 geophysical rocket was launched from the "mid-latitudes" site in 1962

A. No listing of soundings available.

B. Launch times listed are identified as "zone time".

C. Meteorological rockets only.

D. One geophysical rocket data set, 6/18/63-ML, is included in the original data collection, Reference (5). This flight is not listed in the COSPAR tabulations. Reported launch time is confirmed.

E. Not restricted to T,P,D experiments but may include soundings of Winds data also.

F. Launch times listed are identified as Universal Time.

G. Only total number of rocket launches for the year is provided.

H. In addition to indicated meteorological launches, 2 geophysical rockets were launched from the "mid-latitudes" site in 1965.

I. Source unknown, probably Soviet

J Incomplete.

K. Figures for SS and SV ships not separated

L. "Mid-Latitudes" site identified as the Volgograd Station (Kapustin Yar.)

M. Partial listing of soundings available.

TABLE 3 - REFERENCES

(1)	Quiroz.	Quiroz, R S , "Meteorological Rocket Observations and Research in the Soviet Union," Bull Am Met Soc 48, 697-703 (1967)
(2)	WDC-A.	Catalogues of Data and Supplements, World Data Center A, Rockets and Satellites, National Academy of Sciences, Washington, D C
(3)	COSPAR:	USSR Academy of Sciences, Reports to COSPAR, 1961-1968, and COSPAR Information Bulletins
(4)		Khvostikov, I A , Ed , "Results of Rocket Investigations of the Atmosphere for the Period of the IGY and IGC," Trudy, Central Aerological Observatory, Trudy No. 52, Moscow (1964). In Russian.
(5)		Minzner, R. A , P Morgenstern, and S M Mello, "Tabulations of Atmospheric Density, Temperature and Pressure from 437 Rocket and Optical-Probe Soundings During the period 1947 to Early 1965," GCA Technical Report TR-67-10-N, GCA Technology Division, Bedford, Mass (1967)

measured thermodynamic data from these soundings. Negative results were obtained from the survey. Apparently, the only publication containing observational data is a previously available document in Russian by Khvostikov which provided results from some sounding rockets launched during 1957-1959 (Ref. 8).

By international agreement, the Soviets were to have made all this data available through the facilities of the World Data Center. However, only recently has the Soviet data begun to trickle in. This data is delivered to the National Weather Records Center and presumably will become available through the Meteorological Rocket Network.

In hopes of expediting the availability of the Soviet data, a request for publication information was submitted directly to Dr. V. V. Mikhnevich of the USSR Academy of Sciences, Institute of Applied Geophysics. However, her reply merely stated that the data would become available through the World Data Center. A second and similar request was then submitted to Dr. Georgiy Golyshev, former director of the Central Aerological Observatory, USSR A spokesman for Dr Golyshev furnished a similar negative reply.

Accordingly, it now seems doubtful that observational data will be obtained through direct correspondence with Soviet experimenters, in contrast to the favorable cooperation from non-Soviet countries. The remaining alternatives are to await (1) further publications such as the Khvostikov article, and (2) the release of data through the prescribed data exchange channels of the World Data Center

2. Location of Soviet Launch Sites. The geographic location of a rocket launch site is an important parameter in the statistical analysis of the atmospheric structural variability, particularly with respect to diurnal effects near sunrise or sunset Since the IGY, Soviet meteorological rockets have been launched from various stations within and outside the Soviet Union· from several ships at sea, from Heiss Island in Franz Josef Land (80°37'N, 58°03'E), and from what the Soviets have consistently and obscurely referred to merely as "middle latitudes of the USSR" or "middle latitudes of the European part of the USSR".

It was formerly believed that only Kapustin Yar was the site referred to by the Soviets as the "middle latitudes" location. Quiroz and others have subsequently questioned this identification On the basis of time-zone information, presumably for the 1959-1961 soundings, contained in the World Data Center catalogues, Quiroz has favored Tyuratam as the more probable site choice (Refs. 6, 9).

The obscure site(s), therefore, most probably refer to either the Kapustin Yar (48°31'N, 45°48'E) or Tyruatam, Kazakhstan (45°38'N, 63°16'E) - frequently referred to as Baykonur - missile launch complexes. It is possible that both facilities have been involved, and there is the remote but real possibility that a roving, mobile-land site has been utilized. Prior to 1967, positive identification of the "middle latitudes" site has remained an unresolved problem. In 1967 and 1968 the Soviets have identified this site as the Volgograd (formerly Stalingrad) station. This reference would place those launches at Kapustin Yar.

With the aim of establishing which site was employed for launches prior to 1967 the available Soviet sounding information was carefully reviewed. Launch times (zone time) for some of the 1957-1959 Soviet soundings, published by Khvostikov, were compared with the World Data Center listed times for the respective flights. Determination of universal time for all Soviet meteorological rocket launches in general was not possible owing to inconsistencies in the Soviet quoted launch times. Depending upon the year, Soviet reporters have used universal time, local meridian time, zone time, and Moscow time. Furthermore, it was not possible to deduce the location of the "mid-latitude" site from the reported launch time data. A summary of the observed discrepancies is provided in Table 4.

In order to attempt resolution of these issues, GCA communicated with personnel of the World Data Center A, Rockets and Satellites, who handled the original Soviet data concerning these flights In addition, a request was submitted to the National Space Science Data Center to have the original Soviet data re-examined to establish whether both universal time and local (meridian) time were provided by the Soviets along with the sounding listings, or if one of the times was derived after receipt of the records.

Neither the World Data Center A nor the National Space Science Data Center has on file the original Soviet sounding data. Accordingly, neither source could make a first hand response to the time or site location issues. However, all of the available 1957-1958 USSR Rocket Launch Reports were kindly reviewed by personnel at the National Space Science Data Center. No success was achieved in determining either the geographical longitude or time zone of the referenced "mid-latitudes" launch site.

In the Soviet reports only Moscow zone time and UT are listed, and these only occasionally. Since Moscow time is sometimes used as a standard within the USSR, it is presumed that the longitude of interest is not necessarily within the Moscow zone time For the "mid-latitudes" station only launch times are given in contrast to the launches from Heiss Island and various ships for which geographical coordinates are appropriately provided.

TABLE 4

EXAMPLES OF SOVIET REPORTED SOUNDING ROCKET LAUNCH TIMES

Basis: Detailed observational results of rocket soundings during 1957-1959 from Heiss Island, Ship "Ob", and a "Mid-latitudes" site are provided in a publication by Khvostikov. According to the text of the article, "zone time" is reported for each launch. "Zone time" (ZT) is undefined, it may refer to political belt time or to geographical (LT) local time (to the nearest 15° meridian). Khvostikov's times are compared with launch times - Moscow time, Universal time (UT), or unspecified - contained in Soviet Rocket Launch Reports made available through the World Data Center A (WDC-A) in an attempt to deduce the location of the "mid-latitudes" site. Inconsistencies are observed.

1.

Site	Political Belt Time	Geographical Local Time
Heiss Island (58°E)	UT + 5 hrs.	UT + 4
Kapustin Yar (46°E)	+ 4	+ 3
Tyuratam (63°E)	+ 5	+ 4

(Moscow Time - MT equals UT + 3 hrs.)

2. For Heiss Island and "Ob" launches during 1957-58, WDC-A reports MT. Examination of longitudes indicates that Khvostikov's zone time is identical to geographical local time. To be consistent, such should be the case for the "mid-latitudes" site. For "mid-latitudes" launches during this period, WDC-A does not explicitly quote MT - times are left undefined However, from the context it is apparent that MT is probably intended

Examples of Reported "Mid-Latitudes" Launches

Date	WDC-A (MT?)	Khvostikov (ZT)
11 Jul 57	0505	0405
27 Jul 57	0520	0420
21 Dec 57	0740	0745
21 Dec 57	1145	1144
19 Jan 58	1245	1145
24 Jun 58	0445	0545
29 Jun 58	0430	0330

While Heiss Island and "Ob" launch times reported by WDC-A and Khvostikov are compatible - e g. for Heiss Island ZT = MT + 1 = UT + 4 consistently, the same is not true for "mid-latitudes" in which case ZT = MT + 1 = UT + 4 or ZT = MT = UT + 3 or ZT = MT - 1 = UT + 2 as observed in the examples above.

3. For 1959 WDC-A reports UT and LT. Again Khvostikov's ZT for Heiss Island are compatible with the WDC-A times, i.e , ZT = LT = UT + 4. However, for "mid-latitudes" Khvostikov's times are discrepant being consistently UT + 2 as observed in the example following.

Examples of Reported "Mid-Latitudes" Launches

Date	WDC-A (UT)	WDC-A (LT)	Khvostikov (ZT)
12 Mar 59	1109	1509	1309
20 Oct 59	1315	1715	1515
3 Dec 59	0800	1200	1000

According to WDC-A, the UT times came directly from the Soviet reports but the source of the quoted LT is no longer possible to determine If LT times were also provided by the Soviets (as opposed to having been derived by WDC-A personnel subsequent to the receipt of the Soviet reports), then the "mid-latitudes" site would appear to be Tyuratam. However, Khvostikov' data indicates a site westward of Moscow, being neither Tyuratam nor Kapustin Yar

4. On the basis of the consistency and compatibility of Heiss Island launch times between Khvostikov and WDC-A and Soviet National Reports to COSPAR for subsequent years (in which either UT or ZT is given for launches), it is reasonable and possible to determine UT for all Heiss Island launches as listed in the Chronological Bibliography (Table 1)

5. With two exceptions, the same argument applies to shipboard launches. For shipboard launches reported by Borovikov during 1959, ship locations were provided without launch times. For shipboard launches reported in the Soviet National Report to COSPAR (1964) for 1963, launch times (zone time) were provided without ship locations and accordingly, UT cannot be determined For such cases ZT is listed with an * in the Chronological Bibliography.

6. Owing to the incompatibility and lack of consistency with respect to "mid-latitudes" launch sites, UT cannot be determined from quoted zone times. For the sake of coherency, the following formula was tentatively adopted with respect to "mid-latitudes" launches in the Chronological Bibliography: (1) All "mid-latitudes launches are assumed to have occurred at Volgograd (Kapustin Yar) - see discussion in text, (2) if UT is quoted anywhere for

	those launches this time is entered in the Bibliography, ignoring for the time being any other reported times, (3) if only ZT is available for such launches, this time is entered with an *.
Summary:	The location of the Soviet "mid-latitudes" site cannot be established on the basis of reported launch times owing to various inconsistencies in the available data. The Soviets have said this site has always been Volgograd (Kapustin Yar). From data supplied by the Soviets it appears that the site may be Tyuratam. From data reported by Khvostikov, the site may be in any of three or more geographical locations or that several sites or a mobile launch site may be involved.

TABLE 4 - REFERENCES

(1)	Khvostikov:	Khvostikov, I A., Ed , "Results of Rocket Investigations of the Atmosphere for the Period of the IGY and IGC," Trudy, Central Aerological Observatory, Trudy No. 52, Moscow (1964). In Russian
(2)	WDC-A:	Catalogues of Data and Supplements, World Data Center, A, Rockets and Satellites, National Academy of Science Washington, D. C
		Telephone communication with Mr. Richard Y Dow and Miss Ann Wagoner, World Data Center A, Rockets and Satellites (November 1968 and January 1969)
		Telephone communication and subsequent correspondence with Dr. James Vette, Director, National Space Science Data Center, Goddard Space Flight Center, Greenbelt, Maryland.
(3)	COSPAR:	USSR Academy of Sciences, Reports to COSPAR, 1961-1968, and COSPAR Information Bulletins.
(4)	Borovikov:	Borovikov, A. M , Reference Unknown

The question of whether the Soviets, by specifying only "middle latitude" for those launches prior to 1967, were referring to Kapustin Yar or Tyurtatam was posed directly in previously referenced correspondence to the Central Aerological Observatory and separately by the National Space Sciences Data Center to the World Data Center B, Moscow. In both cases the Soviet response identified the "mid-latitude" site for those launches between 1957 and 1967 as the Volgograd station (Kapustin Yar).

Whether this is the final word on the subject or not, it is suggested that despite launch time inconsistencies, the Volgograd site be adopted where appropriate for working purposes in the statistical study. Investigation into this matter will be pursued in the future in order to confirm or deny this site identification.

B. Amendments to Original Data Set of 442 Soundings

With respect to the original set of 442 sounding data, discussed in Section IIA, 25 soundings from Heiss Island were included Data from the soundings, as published in Reference (5), were based on preliminary information limited between the altitudes of 30 and 50 km. During the current study, the complete measured data from these soundings have been acquired. These profiles should, accordingly, supersede the respective soundings in the original set. Furthermore, the original launch times (UT) should all be advanced by one hour as indicated in the amended list in Table 5.

The original set contained 437 soundings. In its present form, however, 442 soundings are included. The additional soundings do not reflect additional data but rather they all result from the segmentation of altitude-data profiles from certain flights which were originally considered single soundings. These flights are listed in Table 6. The launch site-letter code and the ISEQ code (the last character under Present Identification) are both explained in Section III of this document.

TABLE 5

HEISS ISLAND SOUNDINGS INCLUDED IN ORIGINAL DATA SET

Date	Launch Time (GMT)	Date	Launch Time (GMT)
4 Nov 57	0755	25 Oct 58	0800
16 Dec 57	0435	4 Nov 58	1200
19 Jan 58	0845	28 Nov 58	2006
10 Feb 58	0845	8 Dec 58	2000
26 Feb 58	0335	10 Dec 58	1200
1 Apr 58	1200	12 Dec 58	1200
24 Jun 58	0045	10 Jan 59	1200
17 Jul 58	2045	11 Feb 59	2400
27 Jul 58	1510	2 Apr 59	0800
7 Aug 58	0845	8 Oct 59	2100
14 Aug 58	0140	15 Oct 59	2100
23 Oct 58	0320	3 Dec 59	2100

TABLE 6

REDESIGNATION OF FIVE ROCKET SOUNDINGS IN ORIGINAL DATA SET

Former Identification	Present Identification
06/18/63 03 28B KW	6306180328KW 9 6306180328KW +
11/14/63 14 58B KW	6311141458KW 9 6311141458KW +
08/11/53 17 09 SI*	5308531709SI 3 5308531709SI 4
03/07/47 18 23 WS	4703071823WS 3 4703071823WS 4
05/11/50 23 00 WS	5005112300WS 3 5005112300WS 4

*SI (Ship I) was formerly designated SC

III. DATA PROCESSING AND ANALYSIS

In the previous section an original collection of sounding data, compiled during earlier studies, was referred to. This inventory consists of some 442 rocket and optical probe soundings from 25 different launch sites covering the period 1947 to early 1965.

The original data were published in diverse forms. All contained density-altitude profiles, in various systems of units, but frequently temperature and/or pressure data were not obtained or derived. For the entire inventory, temperature-altitude data were computed from the density-altitude profiles using the equation of state and the hydrostatic equation. The gas law was then applied to obtain pressure profiles.

During the processing of the original data, it was occasionally necessary to smooth the reported data in order to obtain more physically realistic profiles. The smoothing consisted of either a selective smoothing process, in which case individual data points were adjusted to eliminate isolated density inversions, or a general smoothing of an entire sounding leg by means of a third order root-mean-square fit.

A complete discussion of these soundings along with tabulations of the density, pressure, and temperature profiles for each sounding appear in GCA Technical Report 67-10-N.

Since these data, along with the expanding data inventory as described in Section II, will subsequently serve as the basis for a comprehensive statistical analysis, careful attention is being placed on a review of all soundings with respect to consistency and reliability of the reported data. Programming efforts toward the initial processing of the original sounding data are the subject of this part of the report.

A. Processing of Original Sounding Data Set

The basic observational data from these soundings was entered on to standard IBM punched cards, one altitude-data point per card plus appropriate identification cards for each sounding. The entire file of the original data set contain nearly 15,000 cards.

The initial step in reorganizing the data consisted of transferring the soundings to magnetic tape, compatible with an IBM 7094 computer. In concert with this data transfer phase, several preliminary screening, checking, and editing procedures were incorporated. A Fortran IV program written for the IBM 7094 computer to transfer the data from cards to tape was expanded to accommodate the processing procedures. This transfer and processing program is described in detail below.

1. Definition of Initial Processing. As presently defined, initial processing consists of the following steps·

(a) Screening of Data
(b) Checking and Editing of Data
(c) Standardization of All Data Formats

Screening, checking, and editing involve an inspection and adjustment of the measured data to produce self-consistent and reliable altitude profiles of temperature, pressure, and density. For the purpose of delineation, screening is defined as non-programmed, while checking and edicint is defined as programmed data inspection and adjustment.

Screening involves a visual inspection of the data prior to and after keypunching to detect obvious keypinching, transfer, or publication errors or unrealistic data. Screening also checks altitude order and conformance of data arrangement to a predetermined format, completeness of the sounding, and other items of this nature that may arise. Detected errors or inconsistencies that are clearly of this type are corrected prior to the submission of the data to any computer programs.

In the programmed checking and editing phase, some tests are of a routine nature, viz to inspect for anticipated types of errors, such as errors undetected during the screening phase, and for general consistency and monotonicity. Other tests that are peculiar to certain sets of data will have to be incorporated, as they occur during the processing of all the data sets.

In the standardization phase, the various forms in which the data exist on cards are converted to a common format for consistency. These data include not only the measured thermodynamic data but also identification data such as the delineation of simultaneous flights or experiments or segmentation of profiles within one flight, or other sounding-related information, such as the values of the 10.7 cm solar flux indices on the day of the sounding and the day preceding the sounding.

2. Format of Sounding Data. In punched-card form each of the 442 original soundings was maintained in one of five different formats with respect to the thermodynamic data. On tape, all sounding identification and related information as well as thermodynamic data have been put into common form. Table 7 contains a breakdown by field and format of the

TABLE 7

LOCATION AND FORMAT OF VARIABLES CONTAINED IN HEADER AND DATA RECORDS ON TAPE OF REFORMED VERSION OF 442 ROCKET SOUNDINGS, ERC Tape #1465 AND 1110 (COPY)

First Header Record:

Format	Definition of Variable	Columns
	Blank Field of 2 Spaces	01-02
A6	Year, Month, Day of Sounding, GMT	03-08
A4	GMT Hour and Minute of Sounding	09-12
A3	Launch Site of Sounding	13-15
A1	ISEQ CODE	16
A2	Technique Letter Code	17-18
F6.1	10.7 cm Solar Flux Index on Day Preceding Sounding	19-24
F6.1	10.7 cm Solar Flux Index on Day of Sounding	25-30
	Blank Field of 12 Spaces Reserved for Four 3-Digit Geomagnetic Field Indices	31-42
F6.2	Local Apparent Time	43-48
F6 1	Sub Solar Angle	49-54
E10.3	Shadow Height Above Launch Site, km	55-64
	Blank Field of 1 Space	65
I4	Highest Altitude of Sounding (Integer), km	66-69
I4	Lowest Altitude of Sounding (Integer), km	70-73
I3	Number of Alt-Data Points in Sounding	74-76

TABLE 7 (Continued)

First Header Record:

Format	Definition of Variable	Columns
A4	Literature Reference for Sounding	77-80
I5	Sequential Count of Record on Tape	81-85

Second Header Record:

	Blank Field of 1 Space	01
A6	Year, Month, Day of Sounding, GMT	02-07
A4	GMT Hour and Minute of Sounding	08-11
A3	Launch Site of Sounding	12-14
A1	ISEQ CODE	15
F9.3	Effective Earth Radius at Launch Site	16-24
F8 6	Ratio of Gravity (go/g)	25-32
	Blank Field of 1 Space	33
I3	Site Number Code	34-36
I3	Technique Number Code	37-39
I2	Latitude Number Code	40-41
A4	Special Note Code Pertaining to Sounding or Data	42-45
I3	Sub Solar Angle Number Code	46-48
I2	10.7 Solar Flux Number Code (Day before Sounding)	49-50
I2	10.7 Solar Flux Number Code (Day of Sounding)	51-52
I2	6-Class Diurnal Number Code	53-54

TABLE 7 (Continued)

Second Header Record: Format	Definition of Variable	Columns
I2	3-Class Diurnal Number Code	55-56
I3	16-Season Number Code	57-59
I1	Extreme Season Number Code	60
I1	4-Season Number Code	61
I2	2-Season Number Code	62-63
I1	8-Season Number Code	64
	Blank Field of 16 Spaces	65-80
I5	Sequential Count of Record on Tape	81-85
Data Card		
A6	Year, Month, Day of Sounding, GMT	01-06
A4	GMT Hour and Minute of Sounding	07-10
A3	Launch Site of Sounding	11-13
A1	ISEQ CODE	14
F8.2	Geometric Altitude of Thermo Data, km	15-22
E12.5	Density Data, kg/cu meter	23-34
F7.1	Temperature Data, deg K	35-41
E12.5	Pressure Data, newtons/sq meter	42-53
	Blank Field of 27 Spaces	54-80
I5	Sequential Count of Record on Tape	81-85

data on ERC Tape numbers 1465 and 1110 (copy) which contain the reformed and standardized versions of the 442 rocket soundings. Each sounding including header records are of identical format although certain data may be missing in particular cases. For each sounding a separater record containing blanks in columns 1 through 80 precedes the two header records. Each record including separater and header records contains a sequential record count, right justified, in columns 81 through 85.

On tape, there is no preferred order to the arrangement of the various launch sites although all soundings are listed chronologically for each site.

A description of the several variables and parameters referred to in Table 7 is contained in Section III.3 (Tables 8-11).

One of the more significant differences among the five original card formats involved the number of significant figures contained in the observational data. Depending upon the experiment and author, between two and seven significant figures in density have been reported. In addition, temperature values have been reported significant to the nearest degree or tenth or hundredth of a degree. Density data included in the card inventory contain two, three or four significant figures and temperature data, to the nearest degree or tenth.

In the reformed and standardized tape version the significant figures in density and temperature are reproduced from the cards, although in the case of density - and pressure, as well - space for five significant figures are provided in anticipation that some of this data can be retrieved from a reexamination and reprocessing of the originally published data. For temperature, space is provided for tenth of a degree accuracy. In all cases of transferred observational data containing fewer significant figures than spaces provided, the remaining field is filled with blank spaces.

Each altitude-data record includes at least altitude plus a density value. Temperature data, however, is not always included. In some cases, temperature profiles were obtained for all or part of a sounding. In other cases, either no temperature data is available or a single value is entered at the top of the sounding or elsewhere throughout the profile.

A second difference in the original data inventory involves the significant figures recorded from available 10.7 cm solar flux index data. Here again data may appear either to the nearest integer value or tenth. Solar flux index data is transferred to tape in the same manner as for temperature, i.e., space is provided for tenth of an integer accuracy but contains a blank character if the data available are accurate only to the nearest integer. For those soundings where solar flux data has not been determined, the appropriate field on the tape header records is left blank.

Finally, with respect to the different formats of the original card inventory, each altitude data card of some of the sounding contained sounding identification and other related information, in addition to date, time, site, and technique information. In other cases, this extra data was included only in the first altitude data card of the sounding. In still other cases, extra data was not included. In the reformed and standardized tape version no extra data is included at this time in any of the altitude data cards

3. Description of Sounding Parameters For reference a complete description is given below of all variables and parameters maintained for each sounding on the reformed and standardized tape version of the original 442 sounding data inventory, ERC Tape #1465 and 1110 (copy). Some of the information presented here has appeared in previous GCA Reports, generally with more thorough description. Appropriate reference is given where such is the case. These descriptions are summarized in the present context to provide a convenient and central source for future reference.

a. Header Record Information

Data entered into the two header records for each sounding contain two types of information: (1) data related to the identification of the sounding, and (2) parameters associable with the time and place of the sounding which are to be used in the statistical analysis of atmospheric structure variations.

The following entries require no explanation:

(1) Date and time of sounding

(2) Highest and lowest altitude of data points

(3) Number of altitude-data points in sounding

(4) Literature reference for sounding (see Reference 5)

(5) Sequential count of record on tape

The following entries are discussed in detail in Reference (10) and are only briefly defined here

10.7 cm solar flux indices -	solar activity indices given for the day of and the day preceding the sounding, considered because of the time delay between the radiational influence of the solar flux and the particulate matter ejected from the sun during a flare or during other periods of high solar activity.
Local apparent time -	local standard time corrected for (1) the longitudinal difference between the site and the center of the standard time zone, and (2) the equation of time, which depends upon the day of the year.
Sub solar angle -	the angle formed by the center of the earth, the center of the sun, and the site of the sounding.
Shadow height -	defined when the sun is below the horizon it is the vertical distance above the launch site which is exposed to direct solar illumination. When the sun is above the horizon, there is no shadow height
Effective earth radius -	radius of earth at site of sounding.
Ratio of gravity (go/g) -	ratio of surface acceleration due to gravity at site of sounding to standard reference gravity value at $45^{\circ}\ 32'\ 33''$.
Numeric codes for site, technique, latitude, sub solar angle, solar flux index, time of day, and season -	numeric codes used in statistical analysis, all thoroughly defined in Reference (10).

It may be noted that for many of the original soundings, in card form, the solar-declination-angle value was entered on the altitude data cards but not on the header cards. This parameter is used to calculate sub solar angle and solar depression angle. These values were not retained in the transfer of sounding data from card to tape because they are calculable from the day of the year of the sounding on the basis of a Fourier analysis series expansion, as described in Reference (10). The equation of time is similarly calculable as discussed in the same reference.

The following entries are defined in the indicated tables of this report:

(1) Launch site of sounding - Table 8

(2) Technique Letter Code - Table 9

(3) Special Note Code - Table 10

(4) ISEQ Code - Table 11

The ISEQ Code is a one-character sequence designation for cases where more than one continuous data sets apply at the same site at the same approximate time. For example, separate soundings are identified in up and down legs of one sounding, in two or more (up to four) sets of independent measurements, or in a single up or down leg which is broken into a maximum of three (highest, lower, and lowest) segments because of large altitude gaps.

4. <u>Description of Reprocessing and Standardization Program</u> The program which transfers the soundings from cards to tape and performs certain initial processing functions is described in this section A flow chart for this program is illustrated in Figure 1.

In addition to standardizing the format of the observational and sounding related data (Table 7) and establishing a general ISEQ code separating segments and experiments of a sounding (Table 11), monotonicity tests are performed on the measured data within a sounding with respect to both altitude and density. Clearly, a monotonicity test cannot be applied to the temperature data and, as mentioned earlier, pressure data were not included in this inventory.

With regard to the altitude monotonicity test each altitude within a sounding, arranged from the highest altitude downward, was tested for inversions. In each case where altitude inversions occurred, it was discovered that the error could be traced to cards out of order in the filed decks, so that an automatic procedure for rearrangement could be programmed.

TABLE 8

LAUNCH SITE CODE IDENTIFICATION

Letter Code	Site	Location	Latitude (deg)	Longitude (deg)
AI	Ascension Island	S. Atlantic Ocean	07.98S	014.42W
AQ	Albuquerque	New Mexico	35.05N	106.40W
BS	Barking Sands	Hawaii	22.05N	159 78W
CA	Carnarvon	Western Australia	24 82S	113.87E
EG	Eglin Field	Florida	30 38N	086 70W
FC	Fort Churchill	Manitoba, Canada	58 73N	093.82W
GM	Guam	Mariana Is. Pacific	13 62N	144.85E
HA	Holloman AF Base	New Mexico	32.85N	106 10W
HI	Heiss Island	Franz Josef Land	81. N	058. E
KW	Kwajalein	Marshal Is Pacific	08 73N	167.73E
KY	Kapustin Yar	Europ. Soviet Union	48.6 N	045 8 E
MS	McMurdo Sound	Antartica	77.88S	166.73E
PM	Point Mugu	California	34.12N	119.12W
SA	Ship A	Equitorial Pacific	00 18N	161.42W
SB	Ship B	North Atlantic	62 06N	063.92W
SC	Ship C	Lancaster Sound	74.57N	094.48W
SD	Ship D	North Atlantic	54.0 N	053.33W
SE	Ship E	North Atlantic	58 43N	055.06W
SF	Ship F	North Atlantic	49 0 N	048 4 W
SG	Ship G	North Atlantic	57.8 N	046.7 W
SH	Ship H	North Atlantic	65.6 N	058. W
TH	Thule	Greenland	76 55N	068.82W
WI	Wallops Island	Virginia	37.83N	075.48W
WO	Woomera	South Australia	31.11S	136.97E
WS	White Sands	New Mexico	32.38N	106.48W

TABLE 9

EXPERIMENT TECHNIQUE CODE IDENTIFICATION

Code	Technique
D	Drag Acceleration
F	Diffusion Coefficient
G	Gauge
L	Light Scattering
M	Mass Spectrometer
R	Radiation Absorption
S	Sound Speed - Grenade
T	Thermistor

TABLE 10

SPECIAL NOTE CODE PERTAINING TO SOUNDING OR DATA

Symbol	Explanation
*	Graphical Data Read by Quiroz
/	Graphical Data Read by Minzner
$	Mass Density Computed From Pressure + Temperature or From Number Density and Molecular Weight By Quiroz
=	Mass Density Computed From Number Density and Molecular Weight By Minzner
+	Temperature Value From Original Source, MRN Publication or Russian Paper, Applied to Density-Altitude Data For Greatest Altitude Only
L	Data Above 220 km Not Used In This Study
M	Data Employed Comes From 3rd Order Root Mean Square Fit of Log (Density) Versus Height Data
N	Two Different Experiments In Same Rocket. Time of These Observations Represents Corrected Launch Time One Hour Earlier Than That Published For The Grenade-Experiment Data
P	Pressure Data Provided By Author
Q	Data Adjusted To Eliminate Identical Values of Density For Success Altitudes To Prevent The Blow Up of The Temperature Calculation
S	Density Data Smoothed In Part
T	Temperature Data Provided By Author

TABLE 11

SIGNIFICANCE OF ISEQ CODE WHICH SEPARATES MULTIPLE SOUNDINGS OCCURRING AT THE SAME TIME AND LOCATION

Which of 4 Sensing Methods	Portion of Sounding	Continuity of Sounding	ISEQ Code
1st Method	One Leg	Continuous	Blank
1st Method	Up Leg	Continuous	1
1st Method	Down Leg	Continuous	2
1st Method	One Leg	Highest Segment	3
1st Method	One Leg	Lower Segment	4
1st Method	One Leg	Lowest Segment	5
1st Method	Up Leg	Highest Segment	6
1st Method	Up Leg	Lower Segment	7
1st Method	Up Leg	Lowest Segment	8
1st Method	Down Leg	Highest Segment	9
1st Method	Down Leg	Lower Segment	+
1st Method	Down Leg	Lowest Segment	-
2nd Method	One Leg	Continuous	A
2nd Method	Up Leg	Continuous	B
2nd Method	Down Leg	Continuous	C
2nd Method	One Leg	Highest Segment	D
2nd Method	One Leg	Lower Segment	E
2nd Method	One Leg	Lowest Segment	F
2nd Method	Up Leg	Highest Segment	G
2nd Method	Up Leg	Lower Segment	H
2nd Method	Up Leg	Lowest Segment	J
2nd Method	Down Leg	Highest Segment	K
2nd Method	Down Leg	Lower Segment	L
2nd Method	Down Leg	Lowest Segment	M
3rd Method	One Leg	Continuous	N
3rd Method	Up Leg	Continuous	O
3rd Method	Down Leg	Continuous	P
3rd Method	One Leg	Highest Segment	Q
3rd Method	One Leg	Lower Segment	R
3rd Method	One Leg	Lowest Segment	S
3rd Method	Up Leg	Highest Segment	T
3rd Method	Up Leg	Lower Segment	U
3rd Method	Up Leg	Lowest Segment	V
3rd Method	Down Leg	Highest Segment	W
3rd Method	Down Leg	Lower Segment	X
3rd Method	Down Leg	Lowest Segment	Y
4th Method	One Leg	Continuous	Z
4th Method	Up Leg	Continuous	/

TABLE 11 (Continued)

Which of 4 Sensing Methods	Portion of Sounding	Continuity of Sounding	ISEQ Code
4th Method	Down Leg	Continuous	*
4th Method	One Leg	Highest Segment	$
4th Method	One Leg	Lower Segment	.
4th Method	One Leg	Lowest Segment	,
4th Method	Up Leg	Highest Segment	=
4th Method	Up Leg	Lower Segment	Unassigned
4th Method	Up Leg	Lowest Segment	Unassigned
4th Method	Down Leg	Highest Segment	Unassigned
4th Method	Down Leg	Lower Segment	Unassigned
4th Method	Down Leg	Lowest Segment	Unassigned

With regard to the density monotonicity test, the density profile was tested for inversions. If an inversion occurs, an error print-out routine is activated identifying the inversion. Owing to the several possible sources for density inversions, no attempt at correction was programmed, but rather, each case is inspected visually. The inversions may occur at isolated points or at several points within certain sounding segments. Many soundings contain inversions and the sources of these errors is presently under investigation

The Fortran IV program listing appears in Table 12, with the various operations described by appropriate comments.

Other programming efforts conducted in this study are considered in the next section.

B. Other Programming Efforts

In addition to the program described in the previous section, work has also been performed reflecting continued progress in the overall problem of the analysis of data contained in the sounding-data inventory. This section describes computer programs dealing with the correction of certain thermistor temperature data and the study of the correlation between atmospheric density and solar flux.

1. Thermistor Temperature Data Correction. Referring to the 1965 Croatan Rawinsonde data, Finger and Woolf (Ref 11) have pointed out certain necessary temperature corrections Bead thermistor errors derive from such considerations as external (solar) radiation incident on the sensor, the sensor's time constant, and the instrument's fall velocity. The necessary corrections vary with each particular type of instrument used. All temperatures measured by Finger and Woolf were obtained using the Arcasonde 1A instrument Along with the (uncorrected) temperature data listings, Mr. Woolf kindly sent a set of applicable corrections, after Drews (Ref. 12), for this particular instrument These are listed in Table 13.

In the Croatan measurements, the temperature samplings were made, in general, at non-integer altitudes. Furthermore, the temperature scale used was Centigrade rather than Kelvin, which is the basis for the present tabulations. Accordingly, it is necessary to correct all the Croatan temperature data for heights in excess of 40 km according to the above scheme and to convert all temperatures to the Kelvin scale.

Toward this end a two part program, listed in Table 14, was written in Fortran IV for the IBM-7094 computer. A flow chart for

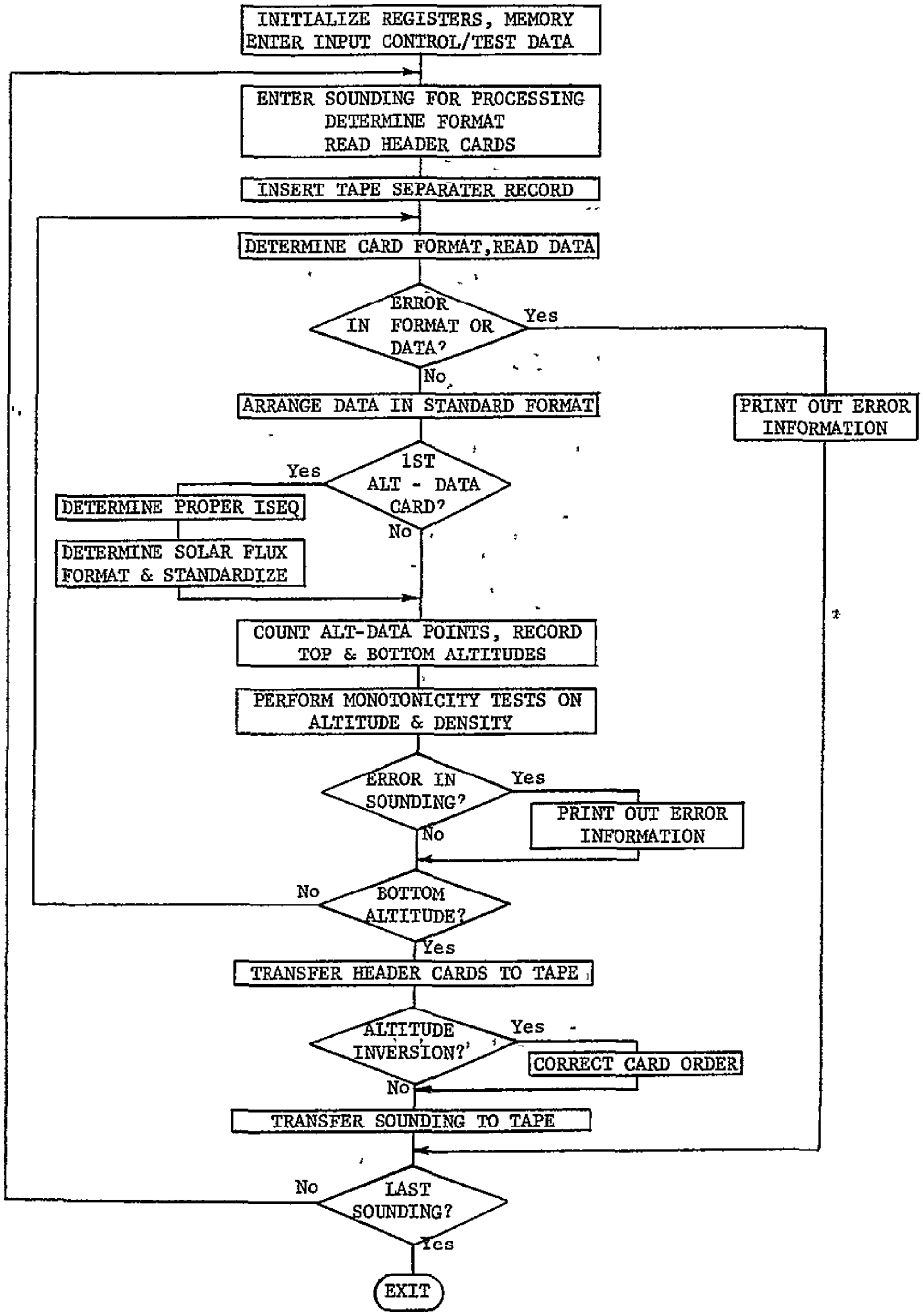

Figure 1. Simplified flow chart original data decks - reprocessing - 1.

TABLE 12. FORTRAN IV COMPUTER PROGRAM LISTING

```
$JOB  I40610 2 IN-LAB MINZNER-DECK 1000                020 180
$EXECUTE         IBJOB
$IBJOB           ALTIO
$IBFTC MAIN
C     ORIGINAL DATA DECKS - REPROCESSING - 1
C                                         E. D. SCHULTZ, GCA, 1 MARCH 1969
C                            CALL    (A5) ERC 1451 RING OUT
C                            CALL    (B5) ERC 1110 RING IN
C                            CALL    (B6) SCRATCH RING IN
C                                     ERC TAPE 1206, MASTER OF 442 SOUNDINGS
C                                     ERC TAPE 1451 , COPY OF TAPE 1206
C                                     ERC TAPE 1110 , OUTPUT , REFORMED VERSION
C                                                    OF 442 SOUNDINGS
C                                     ERC TAPE 1465 , COPY OF TAPE 1110
C                                         THIS PROGRAM REPROCESSES ORIGINAL
C                                         ROCKET SOUNDING DATA DECKS, 442 IN
C                                         NUMBER, WHICH HAD BEEN MAINTAINED IN
C                                         5 DIFFERENT FORMAT TYPES. PROGRAM
C                                         PUTS ALL DECKS INTO STANDARD FORMAT
C                                         AS FOLLOWS...
C
C  NAME     FORMAT  DEFINITION OF VARIABLE                                COLMS
C
C  IDATE    A6      YEAR,MONTH,DAY OF ROCKET SOUNDING, GMT                01-06
C  ITIME    A4      GMT HOUR AND MINUTE OF ROCKET SOUNDING                07-10
C  ISITE    A3      LAUNCH SITE OF SOUNDING                               11-13
C  ISEQ     A1      A ONE-CHARACTER SEQUENCE DESIGNATION FOR CASES
C                   WHERE MORE THAN ONE DATA SET APPLIES AT THE
C                   SAME SITE, I.E., IN UP AND DOWN LEGS OF ONE
C                   SOUNDING, IN TWO OR MORE SETS OF INDEPENDENT
C                   MEASUREMENTS AT THE SAME SITE, IN A SINGLE UP
C                   OR DOWN LEG BROKEN INTO SEVERAL SEGMENTS
C                   BECAUSE OF LARGE GAPS, OR A COMBINATION OF THESE  14
C  ALT      F8.2    ALTITUDE OF ROCKET THERMO DATA IN KM                  15-22
C  DENSI    E12.5   ROCKET DENSITY IN KG/(CUBIC METER)                    23-34
C  TEMP     F7.1    ROCKET TEMPERATURE IN DEGREES K                       35-41
C  PRESS    E12.5   ROCKET PRESSURE IN NEWTONS/(SQUARE METER)             42-53
C  ISEQ     I5      SEQUENTIAL COUNT OF RECORD ON TAPE                    81-85
C
C                                         NO PRESSURES ARE INCLUDED IN THE
C                                         CURRENT REPROCESSED DECKS.
C                                         PROGRAM ALSO PERFORMS MONOTONICITY
C                                         TESTS ON ALTITUDE AND DENSITY.
C
C                                         EACH SOUNDING IS PRECEDED BY A BLANK
C                                         SEPARATER RECORD (WHICH INCLUDES A
C                                         RECORDS COUNT - IREC) FOLLOWED BY
C                                         TWO HEADER REDORDS CONTAINING THE
C                                         FOLLOWING INFORMATION...
C
C     FIRST HEADER RECORD
C
C  NAME     FORMAT  DEFINITION OF VARIABLE                                COLMS
C
C                   BLANK FIELD OF 2 SPACES                               01-02
C  IDATE    A6      YEAR, MONTH, DAY OF SOUNDING, GMT                     03-08
C  ITIME    A4      GMT HOUR AND MINUTE OF SOUNDING                       09-12
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C  ISITE    A3     LAUNCH SITE OF SOUNDING                               13-
C  ISEQ     A1     SEE IDENTIFICATION ABOVE                                16
C  TECH     A2     TECHNIQUE LETTER CODE                                 17-
C  SOL1     F6.1   10.7 CM SOLAR FLUX INDEX ON DAY PRECEDING
C                  SOUNDING                                              19-
C  SOL2     F6.1   10.7 CM SOLAR FLUX INDEX ON DAY OF SOUNDING           25-
C                  BLANK FIELD OF 12 SPACES RESERVED FOR FOUR
C                  3-DIGIT GEOMAGNETIC FIELD INDICES                     31-
C  TM       F6.2   LOCAL APPARENT TIME                                   43-
C  SUB      F6.1   SUB SOLAR ANGLE                                       49-
C  SHDW     E10.3  SHADOW HEIGHT ABOVE LAUNCH SITE, KM                   55-
C                  BLANK FIELD OF 1 SPACE                                 65
C  TOPA     I4     HIGHEST ALTITUDE OF SOUNDING (INTEGER), KM            66-
C  BOTA     I4     LOWEST ALTITUDE OF SOUNDING (INTEGER), KM             70-
C  L        I3     NUMBER OF ALT-DATA POINTS IN SOUNDING                 74-
C  REF      A4     LITERATURE REFERENCE FOR SOUNDING                     77-
C  ISEQ     I5     SEQUENTIAL COUNT OF RECORD ON TAPE                    81-
C
C     SECOND HEADER RECORD
C
C                  BLANK FIELD OF 1 SPACE                                 01
C  IDATE    A6     YEAR, MONTH, DAY OF SOUNDING, GMT                     02-
C  ITIME    A4     GMT HOUR AND MINUTE OF SOUNDING                       08-
C  ISITE    A3     LAUNCH SITE OF SOUNDING                               12-
C  ISEQ     A1     SEE IDENTIFICATION ABOVE                               15
C  RAD      F9.3   EFFECTIVE EARTH RADIUS AT LAUNCH SITE                 16-
C  GRAV     F8.6   INVERTED RATIO OF GRAVITY                             25-
C                  BLANK FIELD OF 1 SPACE                                 33
C  STCD     I3     SITE NUMBER CODE                                      34-
C  TKCD     I3     TECHNIQUE NUMBER CODE                                 37-
C  LTCD     I2     LATITUDE NUMBER CODE                                  40-
C  NOTE     A4     SPECIAL NOTE CODE PERTAINING TO DATA                  42-
C  SBCD     I3     SUB SOLAR ANGLE NUMBER CODE                           46-
C  SOCD1    I2     10.7 SOLAR FLUX NUMBER CODE (DAY PRECEDING
C                  SOUNDING)                                             49-
C  SOCD2    I2     10.7 SOLAR FLUX NUMBER CODE (DAY OF SOUNDING)         51-
C  DICD6    I2     6-CLASS DIURNAL NUMBER CODE                           53-
C  DICD3    I2     3-CLASS DIURNAL NUMBER CODE                           55-
C  SEA16    I3     16-SEASON NUMBER CODE                                 57-
C  SEAX     I1     EXTREME SEASON NUMBER CODE                             60
C  SEA4     I1     4-SEASON NUMBER CODE                                   61
C  SEA2     I2     2-SEASON NUMBER CODE                                  62-
C  SEA8     I1     8-SEASON NUMBER CODE                                   64
C                  BLANK FIELD OF 16 SPACES                              65-
C  ISEQ     I5     SEQUENTIAL COUNT OF RECORD ON TAPE                    81-
      NSET=0
      DIMENSION ALTS(100),DENXS(100),DENYS(100),TEMPS(100)
      INTEGER YR,DAY,HR,Z
      READ (5,900) NDCKS
900   FORMAT(I4)
C                                   NDCKS IS THE NUMBER OF DECKS TO BE
C                                   PROCESSED DURING A GIVEN RUN. NSET
C                                   A REGISTER OF THE DECK NUMBER.
C                                   IREC IS A CONSECUTIVE COUNTER
C                                   REGISTERING EVERY RECORD PUT ON
C                                   OUTPUT TAPE INCLUDING SEPARATER
C                                   CARD, HEADER CARDS, AND ALL ALTITUD
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C                                                   DATA CARDS.
      READ (5,901) PER,ZET,MSIGN,KPLUS,LTRA,LTRB,LTRC,LTRY,LTRZ,KBLNK1,
     1KBLNK2,BLNK1,BLNK4,BLNK5,BLNK6
  901 FORMAT(9A1,A1,A2,A1,A4,A5,A6)
C                                                   READ CHARACTERS .0-+ABCYZ AND BLANK
C                                                   FIELDS KBLNK1,2 AND BLNK1-BLNK6 USED
C                                                   IN DENSITY FORMAT TESTING AND
C                                                   CODE TESTING.
      ISTAY=0
      IREC=0
      READ (5,983) GM,HI,ZKY,ZMS,TH,AI,WO,EG,FC,BS,SF,SG,SH,HA,SA,SB,AQ,
     1CA,SE,ENDALT,K1,K2,K3,K4,K9,J00,J01,J02,J03,J04,J05
  983 FORMAT(3A2,3A2,3A2,3A2,3A2,3A2,A2,A6,5A1,6A2)
      READ (5,984) J06,J07,J08,J09,J10,J11,J12,J13,J14,J17,J18,J19,J20,
     1J21,J22,J24,J27,J29,J30,J48,J49,J50,J51,J52,J53,J54,J55,J58,J61,
     2J62,J63,J64,J65
  984 FORMAT(6A2,6A2,6A2,6A2,6A2,3A2)
C                                                   READ SITE DESIGNATIONS AND SELECTED
C                                                   NUMERALS FOR USE IN SITE, ISEQ, AND
C                                                   DATE TESTING.
C                                                   ENDALT IS ALT OF FINAL ALT-DATA CARD
C                                                   USED FOR TRIPOUT TO END THE PROGRAM.
   45 READ (8,902) ISIGN,KIND
  902 FORMAT(18XA1,I1)
C                                                   READ IST SEPARATER CARD WHICH
C                                                   INCLUDES IN COLS. 19 AND 20 A
C                                                   -1,-2,-3,-4, OR -5 IDENTIFYING I OF 5
C                                                   DIFFERENT FORMATS OF THE ALT-DATA
C                                                   CARDS. SET KIND = THIS NUMERIC CODE.
C                                                   ISIGN SHOULD ALWAYS EQUAL MSIGN (-).
   50 NSET = NSET+1
C                                                   INCREMENT SOUNDING COUNT.
      IF(NDCKS-NSET) 1000,60,60
   60 NORD=1
C                                                   NORD IS A REGISTER DESIGNATING
C                                                   IST, 2ND, OR HIGHER NUMBER ALT-DATA
C                                                   RECORD IN A SOUNDING.
      DENSA=0.0E-38
      DENSB=0.0E-38
      DENSC=0.0E-38
      READ (8,938) MON,DAY,YR,Z,HR,MIN,LTR,SITE,TECH,SOL1,SOL2,TM,SUB,
     1SHDW1,SHDW2,NOTE,REF
  938 FORMAT(2XA2,1XA2,1XA2,A1,A2,1XA2,A1,1XA2,1XA1,1XA5,1XA5,3A6,A3,12X
     1A4,1XA4)
C                                                   READ IST HEADER CARD. SEE COMMENTS
C                                                   AT BEGINNING OF PROGRAM FOR VARIABLE
C                                                   DEFINITION.
      READ (8,939) RAD1,RAD2,GRAV1,GRAV2,STCD,LTCD,TKCD,SEA16,SEAX,SEA4,
     1SEA2,SEA8,SBCD,SOCD1,SOCD2,DICD6,DICD3
  939 FORMAT(18XA6,A3,4XA6,A2,15XA3,A1,2A3,2A1,A2,A1,A3,4A2)
C                                                   READ 2ND HEADER CARD.
      IREC = IREC+1
C                                                   INCREMENT RECORD COUNT BEFORE
C                                                   TRANSFERRING CARD TO TAPE.
      WRITE (9,962) IREC
      WRITE (6,962) IREC
  962 FORMAT(80XI5)
```

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C                                          TRANSFER SEPARATER CARD TO TAPE,
C                                          DROPPING FORMAT IDENTIFICATION CODE.
C                                          LOGICAL UNIT 9 IS OUTPUT TAPE,
C                                          LOGICAL UNIT 6 IS OFF LINE PRINTER.
      IF(KIND.NE.1.AND.KIND.NE.2.AND.KIND.NE.3.AND.KIND.NE.4.AND.KIND.
     1NE.5) GO TO 800
C                                          IF FORMAT CANNOT BE DETERMINED, GO T
C                                          ERROR SECTION.
      GO TO (101,102,103,104,104),KIND
C                                          BRANCH TO TYPE OF FORMAT.  KIND=4 AN
C                                          KIND=5 ARE IDENTICAL WITH RESPECT TO
C                                          DENSITY FORMAT.
101   READ (8,904) JFLD,ALT,DENSQ,DENSR,TEMP,SFLX1,SFLX2
904   FORMAT(A2,14X2A6,A4,1XA6,4XA5,A6)
C                                          READ ALT-DATA CARD. JFLD IS A TRAP
C                                          FOR NEXT SEPARATER CARD. DENS IS
C                                          READ IN TWO A-FORMAT FORMS FOR
C                                          MANIPULATION. READ SOLAR FLUX DATA
C                                          IF INCLUDED ON ALT-DATA CARDS.
      IF(JFLD.EQ.KBLNK2) GO TO 200
C                                          IF CARD JUST READ IN  IS A SEPARATER
C                                          CARD TRANSFER.
      IF(DENSR.EQ.BLNK4) GO TO 110
C                                          IF THIS CARD DOES NOT CONTAIN DENSIT
C                                          DATA, TRANSFER.
      WRITE (11,905) DENSQ,DENSR,DENSQ,DENSR
905   FORMAT(1XA6,1XA4,1XA6,1XA4)
C                                          DENSITY IS WRITTEN TWICE ON SCRATCH
C                                          TAPE.
      GO TO 108
102   READ (8,906) JFLD,ALT,DENSQ,DENSR,TEMP,SFLX1,SFLX2
906   FORMAT(A2,14XA6,A5,A4,1XA6,5XA5,A6)
      IF(JFLD.EQ.KBLNK2) GO TO 200
      IF(DENSR.EQ.BLNK4) GO TO 110
      WRITE (11,907) DENSQ,DENSR,DENSQ,DENSR
907   FORMAT(2XA5,1XA4,2XA5,1XA4)
      GO TO 108
103   READ (8,906) JFLD,ALT,DENSQ,DENSR,TEMP,SFLX1,SFLX2
      IF(JFLD.EQ.KBLNK2) GO TO 200
      IF(DENSR.EQ.BLNK4) GO TO 110
      WRITE (11,908) DENSQ,DENSR,DENSQ,DENSR
908   FORMAT(1XA5,2XA4,1XA5,2XA4)
      GO TO 108
104   READ (8,909) JFLD,ALT,DENS1,DENS2,DENS3,DENSQ,DENSR,TEMP,SFLX1,
     1SFLX2
909   FORMAT(A2,14XA6,3A1,A2,A4,1XA6,5XA5,A6)
      IF(JFLD.EQ.KBLNK2) GO TO 200
      IF(DENSR.EQ.BLNK4) GO TO 110
C                                          FOLLOWING INSTRUCTIONS MANIPULATE
C                                          FORMAT OF -4 OR -5 TYPE DATA.
      IF(DENS1.EQ.BLNK1.AND.DENS2.EQ.ZET.AND.DENS3.EQ.PER) GO TO 105
      WRITE (11,975) DENSR
975   FORMAT(4H+0.1,A4)
C                                          SHIFT DECIMAL POINT AND ADJUST
C                                          EXPONENT.
      BACKSPACE 11
      READ (11,976) EFORM
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```
976    FORMAT(E8.1)
       BACKSPACE 11
       EFORM = EFORM*10.0
       WRITE (11,976) EFORM
       BACKSPACE 11
       READ (11,977) DENSR
977    FORMAT(4XA4)
       BACKSPACE 11
       WRITE (11,910) DENS1,DENS3,DENS2,DENSQ,DENSR,DENS1,DENS3,DENS2,
      1DENSQ,DENSR
910    FORMAT(1X3A1,A2,2XA4,1X3A1,A2,2XA4)
       GO TO 108
105    WRITE (11,911) DENS3,DENSQ,DENSR,DENS3,DENSQ,DENSR
911    FORMAT(2XA1,A2,3XA4,2XA1,A2,3XA4)
108    BACKSPACE 11
       READ (11,912) DENSI,DENSX.DENSY
912    FORMAT(E12.5,2A6)
       BACKSPACE 11
C                                       READ DENSITY BACK TWICE FROM SCRATCH
C                                       TAPE, FIRST IN E-FORMAT
C                                       FOR TESTING, THEN IN A-FORMAT
C                                       CONTAINING PROPERLY SPACED BLANKS
C                                       - IN STANDARD FORMAT - FOR TRANSFER
C                                       TO OUTPUT TAPE.
110    WRITE (11,970) ALT
970    FORMAT(1XA6)
C                                       TRANSFER ALT TO SCRATCH TAPE IN
C                                       A FORMAT AND READ IT BACK AS AALT IN
C                                       F FORMAT FOR TESTING.
       BACKSPACE 11
       READ (11,971) AALT
971    FORMAT(F7.2)
       BACKSPACE 11
       WRITE (11,988) BLNK6
C                                       ADVANCE SCRATCH TAPE TO AVOID OVERUSE
C                                       OF SAME SPOT.
       BALT = AALT
C                                       SET BOTTOM ALTITUDE EQUAL TO CURRENT
C                                       ALTITUDE.
       GO TO (115,125,135),NORD
C                                       ALT AND DENSI ARE NOW IN STANDARD
C                                       FORMAT. PERFORM MONOTONICITY TESTS.
C                                       NORD REGISTER CONTROLS ORDER OF
C                                       ALTITUDE-DATA CARDS.
115    NORD=2
C                                       115 ENTERED ON IST (HIGHEST) ALT-DATA
C                                       CARD.
C                                       INCREMENT NORD REGISTER.
       ISEQ = KBLNK1
C                                       CLEAR ISEQ SPACE.
C                                       FOLLOWING INSTRUCTIONS TEST CERTAIN
C                                       PREDETERMINED SOUNDINGS TO SET
C                                       ISEQ CODE.
       IF(SITE.EQ.GM.OR.SITE.EQ.HI.OR.SITE.EQ.ZKY.OR.SITE.EQ.ZMS.OR.SITE.
      1EQ.TH.OR.SITE.EQ.AI.OR.SITE.EQ.WO.OR.SITE.EQ.HA.OR.SITE.EQ.SA.OR.
      2SITE.EQ.SB.OR.SITE.EQ.AQ.OR.SITE.EQ.CA) GO TO 111
       IF(MON.EQ.J01.AND.DAY.EQ.J27.AND.YR.EQ.J58.AND.HR.EQ.J18.AND.MIN.
```

```
     1EQ.J48.AND.LTR.EQ.LTRB) ISEQ = LTRC
      IF(MON.EQ.J12.AND.DAY.EQ.J07.AND.YR.EQ.J63.AND.HR.EQ.J13.AND.MIN.
     1EQ.J11.AND.LTR.EQ.LTRB) ISEQ = LTRC
      IF(MON.EQ.J06.AND.DAY.EQ.J07.AND.YR.EQ.J62.AND.HR.EQ.J00.AND.MIN.
     1EQ.J05.AND.LTR.EQ.LTRB) ISEQ = LTRC
      IF(MON.EQ.J06.AND.DAY.EQ.J06.AND.YR.EQ.J61.AND.HR.EQ.J21.AND.MIN.
     1EQ.J48.AND.LTR.EQ.LTRC) ISEQ = LTRC
      IF(ISEQ.NE.KBLNK1) GO TO 111
      IF(Z.EQ.LTRZ.AND.LTR.EQ.KBLNK1) ISEQ = K3
      IF(Z.EQ.LTRY.AND.LTR.EQ.KBLNK1) ISEQ = K4
      IF(Z.EQ.LTRZ.AND.LTR.EQ.LTRB) ISEQ = K9
      IF(Z.EQ.LTRY.AND.LTR.EQ.LTRB) ISEQ = KPLUS
      IF(ISEQ.NE.KBLNK1) GO TO 111
      IF(MON.EQ.J03.AND.DAY.EQ.J09.AND.YR.EQ.J63.AND.HR.EQ.J00.AND.MIN.
     1EQ.J01.AND.LTR.EQ.LTRA) GO TO 111
      IF(MON.EQ.J03.AND.DAY.EQ.J09.AND.YR.EQ.J63.AND.HR.EQ.J00.AND.MIN.
     1EQ.J01.AND.LTR.EQ.LTRB) GO TO 111
      IF(MON.EQ.J02.AND.DAY.EQ.J13.AND.YR.EQ.J64.AND.HR.EQ.J04.AND.MIN.
     1EQ.J30.AND.LTR.EQ.LTRA) GO TO 111
      IF(MON.EQ.J02.AND.DAY.EQ.J13.AND.YR.EQ.J64.AND.HR.EQ.J04.AND.MIN.
     1EQ.J30.AND.LTR.EQ.LTRB) GO TO 111
      IF(LTR.EQ.LTRA) ISEQ = K1
      IF(LTR.EQ.LTRB) ISEQ = K2
  111 TALT = AALT
C                                          RECORD HIGHEST ALTITUDE.
      L=1
      I=1
C                                          L AND I USED TO COUNT ALT-DATA
C                                          CARDS IN SOUNDING.
C                                          FOLLOWING INSTRUCTIONS TEST CERTAIN
C                                          PREDETERMINED SOUNDINGS TO EXTRACT
C                                          AND STANDARDIZE SOLAR FLUX DATA.
      IF(SITE.EQ.GM.OR.SITE.EQ.HI.OR.SITE.EQ.ZKY.OR.SITE.EQ.ZMS.OR.SITE
     1EQ.TH.OR.SITE.EQ.AI.OR.SITE.EQ.WO.OR.SITE.EQ.EG.OR.SITE.EQ.FC.OR.
     2SITE.EQ.BS.OR.SITE.EQ.SF.OR.SITE.EQ.SG.OR.SITE.EQ.SH) GO TO 3000
      IF(SITE.EQ.AQ) GO TO 2001
      IF(SITE.EQ.SE) GO TO 2010
      IF(MON.EQ.J08.AND.DAY.EQ.J07.AND.YR.EQ.J51) GO TO 2004
      IF(MON.EQ.J05.AND.DAY.EQ.J10.AND.YR.EQ.J65) GO TO 2008
      IF(MON.EQ.J05.AND.DAY.EQ.J11.AND.YR.EQ.J65) GO TO 2008
      IF(MON.EQ.J12.AND.DAY.EQ.J17.AND.YR.EQ.J64) GO TO 2008
      IF(MON.EQ.J11.AND.DAY.EQ.J17.AND.YR.EQ.J64) GO TO 2008
      IF(MON.EQ.J06.AND.DAY.EQ.J17.AND.YR.EQ.J64) GO TO 2008
      IF(MON.EQ.J06.AND.DAY.EQ.J18.AND.YR.EQ.J64) GO TO 2008
      IF(MON.EQ.J05.AND.DAY.EQ.J12.AND.YR.EQ.J64) GO TO 2009
      IF(MON.EQ.J06.AND.DAY.EQ.J24.AND.YR.EQ.J55) GO TO 2006
      IF(MON.EQ.J06.AND.DAY.EQ.J20.AND.YR.EQ.J50) GO TO 2006
      IF(MON.EQ.J09.AND.DAY.EQ.J13.AND.YR.EQ.J51) GO TO 2006
      IF(MON.EQ.J10.AND.DAY.EQ.J22.AND.YR.EQ.J52) GO TO 2006
      IF(MON.EQ.J08.AND.DAY.EQ.J05.AND.YR.EQ.J53) GO TO 2006
      IF(MON.EQ.J07.AND.DAY.EQ.J19.AND.YR.EQ.J54) GO TO 2006
      IF(MON.EQ.J08.AND.DAY.EQ.J06.AND.YR.EQ.J48) GO TO 2006
      IF(MON.EQ.J09.AND.DAY.EQ.J29.AND.YR.EQ.J49) GO TO 2006
      IF(MON.EQ.J11.AND.DAY.EQ.J21.AND.YR.EQ.J50) GO TO 2006
      IF(MON.EQ.J08.AND.DAY.EQ.J11.AND.YR.EQ.J53.AND.LTR.EQ.LTRZ) GO TO
     12011
      IF(MON.EQ.J05.AND.DAY.EQ.J11.AND.YR.EQ.J50.AND.LTR.EQ.LTRZ) GO TO
```

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      12011
       IF(MON.EQ.J08.AND.DAY.EQ.J11.AND.YR.EQ.J53.AND.LTR.EQ.LTRY) GO TO
      12012
       IF(MON.EQ.J05.AND.DAY.EQ.J11.AND.YR.EQ.J50.AND.LTR.EQ.LTRY) GO TO
      12012
       IF(MON.EQ.J09.AND.DAY.EQ.J29.AND.YR.EQ.J53.AND.LTR.EQ.LTRA) GO TO
      12011
       IF(MON.EQ.J09.AND.DAY.EQ.J29.AND.YR.EQ.J53.AND.LTR.EQ.LTRB) GO TO
      12012
       GO TO 3000
 2001  IF(MON.EQ.J08.AND.DAY.EQ.J20.AND.YR.EQ.J50) GO TO 2002
       IF(MON.EQ.J09.AND.DAY.EQ.J10.AND.YR.EQ.J50) GO TO 2003
       IF(MON.EQ.J10.AND.DAY.EQ.J14.AND.YR.EQ.J50) GO TO 2003
       IF(MON.EQ.J09.AND.DAY.EQ.J27.AND.YR.EQ.J52) GO TO 2003
       IF(MON.EQ.J10.AND.DAY.EQ.J11.AND.YR.EQ.J52) GO TO 2003
       IF(MON.EQ.J10.AND.DAY.EQ.J12.AND.YR.EQ.J52) GO TO 2004
       IF(MON.EQ.J09.AND.DAY.EQ.J08.AND.YR.EQ.J50) GO TO 2008
 2006  SOL1 = SFLX1
 2007  WRITE (11,988) SFLX2
 988   FORMAT(A6)
       BACKSPACE 11
       READ (11,989) SFLX2
 989   FORMAT(1XA5)
       BACKSPACE 11
       SOL2 = SFLX2
       GO TO 3000
 2008  SOL1 = SFLX1
 2009  WRITE (11,988) SFLX2
       BACKSPACE 11
       READ (11,987) SFLX2
 987   FORMAT(A5)
       BACKSPACE 11
       SOL2 = SFLX2
       GO TO 3000
 2002  SOL1 = BLNK5
       SOL2 = BLNK5
       GO TO 3000
 2003  SOL1 = SFLX1
       SOL2 = BLNK5
       GO TO 3000
 2004  SOL1 = BLNK5
       GO TO 2007
 2010  SOL1 = BLNK5
       GO TO 3000
 2011  SAVE1 = SFLX1
       SAVE2 = SFLX2
       GO TO 2006
 2012  SFLX1 = SAVE1
       SFLX2 = SAVE2
       GO TO 2006
 3000  ALTA = AALT
 C                                     STORE IST ALT FOR TESTING.
       IF(DENSR.NE.BLNK4) GO TO 118
 116   DENSX = BLNK6
       DENSY = BLNK6
       GO TO 119
 C                                     IF NO DENSITY THIS CARD STORE BLANKS
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C                                                IN APPROPRIATE FIELD IN OUTPUT TAPE
  118   DENSA = DENSI
C                                                IF DENSITY IS PRESENT, STORE FIRST
C                                                DENSI FOR TESTING.
  119   ALTS(I) = ALT
        DENXS(I) = DENSX
        DENYSYI) = DENSY
        TEMPS(I) = TEMP
C                                                STORE ALT,DENS,AND TEMP IN
C                                                DIMENSIONED ARRAY FOR LATER TRANSFE
C                                                TO TAPE.
        IF(MON.EQ.J06.AND.DAY.EQ.J24.AND.YR.EQ.J65.AND.HR.EQ.J06.AND.MIN
       1EQ.J07.AND.ALT.EQ.ENDALT) GO TO 200
C                                                TEST FOR LAST RECORD.
  120   GO TO (101,102,103,104,104),KIND
C                                                ACQUIRE NEXT CARD.
  125   NORD=3
C                                                125 ENTERED ON 2ND ALT-DATA CARD.
C                                                INCREMENT NORD REGISTER.
        L=2
        I=2
        ALTB = AALT
C                                                STORE 2ND ALT FOR TESTING.
        IF(DENSR.EQ.BLNK4) GO TO 116
        IF(DENSA.EQ.0.0E-38) GO TO 126
        DENSB = DENSI
        GO TO 119
  126   DENSA = DENSI
        GO TO 119
C                                                THE PRECEEDING FEW INSTRUCTIONS
C                                                EQUATE DENSI WITH EITHER DENSA OR
C                                                DENSB DEPENDING ON WHETHER THIS IS
C                                                THE FIRST OR SECOND DENSITY DATA.
  135   L = L+1
C                                                135 ENTERED ON 3RD OR HIGHER
C                                                NUMBERED ALT-DATA CARD.
        I = I+1
C                                                INCREMENT L AND I TO MAINTAIN COUNT
C                                                OF NUMBER OF ALT-DATA CARDS
C                                                IN SOUNDING.
        ALTC = AALT
C                                                STORE PRESENT VALUE OF ALT IN ALTC.
        IF(ALTA.GT.ALTB.AND.ALTB.GT.ALTC) GO TO 136
        GO TO 810
C                                                TEST PREVIOUS TWO ALTITUDES IF
C                                                MONOTONICALLY DECREASING. IF TEST
C                                                FAILS, TRANSFER TO ERROR PRINT OUT
C                                                SECTION.
  136   ALTA = ALTB
        ALTB = ALTC
C                                                WHETHER OR NOT TEST PASSED REPLACE
C                                                PREVIOUS AND PRESENT ALT FOR TESTING
C                                                WITH NEXT CARD.
        IF(DENSR.EQ.BLNK4) GO TO 116
C                                                IF DENSI DATA NOT INCLUDED THIS CARD
C                                                DENSI TEST IS NOT MADE.
        IF(DENSA.EQ.0.0E-38.AND.DENSB.EQ.0.0E-38) GO TO 138
```

```
      IF(DENSA.NE.0.0E-38.AND.DENSB.EQ.0.0E-38) GO TO 139
C                                             BRANCH TO LOCATIONS SPECIFIED IF THIS
C                                             EITHER THE FIRST OR SECOND DENSI DATA
      DENSC = DENSI
C                                             THIS IS 3RD OR HIGHER NUMBERED DENSI
C                                             DATA, SO TEST CAN BE MADE.
      IF(DENSA.LT.DENSB.AND.DENSB.LT.DENSC) GO TO 137
      GO TO 820
C                                             TEST PREVIOUS TWO DENSI VALUES IF
C                                             MONOTONICALLY INCREASING. IF TEST
C                                             FAILS, TRANSFER TO ERROR PRINT OUT
C                                             SECTION.
 137  DENSA = DENSB
      DENSB = DENSC
C                                             WHETHER OR NOT TEST PASSED, REPLACE
C                                             PREVIOUS AND PRESENT DENSI VALUES
C                                             FOR TESTING WITH NEXT CARD.
      GO TO 119
 138  DENSA = DENSI
      GO TO 119
C                                             CURRENT DENSI IS 1ST DENSI VALUE.
 139  DENSB = DENSI
      GO TO 119
C                                             CURRENT DENSI IS 2ND DENSI VALUE.
 277  READ (11,6003) TOPA,BOTA
 6003 FORMAT(7XA3,4XA3)
      GO TO 279
 200  TALT = TALT+0.50
C                                             200 IS ENTERED UPON READING SEPARATER
C                                             CARD. ALT FIELD CONTAINS FORMAT
C                                             TYPE (KIND).
      BALT = BALT+0.50
C                                             ROUND OFF TOP AND BOTTOM ALTITUDES
C                                             TO INTEGER VALUE.
      WRITE (11,915) ALT,TALT,BALT
 915  FORMAT(A6,2F7.2)
      BACKSPACE 11
      IF(MON.EQ.J06.AND.DAY.EQ.J24.AND.YR.EQ.J65.AND.HR.EQ.J06.AND.MIN.
     1EQ.J07.AND.ALT.EQ.ENDALT) GO TO 277
C                                             IF THIS IS LAST CARD TO BE PROCESSED
C                                             TRANSFER.
      READ (11,917) ISIGN,KIND,TOPA,BOTA
 917  FORMAT(2XA1,I1,3XA3,4XA3)
 279  BACKSPACE 11
      IREC = IREC+1
      WRITE (9,963) YR,MON,DAY,HR,MIN,SITE,ISEQ,TECH,SOL1,SOL2,TM,SUB,
     1SHDW1,SHDW2,TOPA,BOTA,L,REF,IREC
      WRITE (6,963) YR,MON,DAY,HR,MIN,SITE,ISEQ,TECH,SOL1,SOL2,TM,SUB,
     1SHDW1,SHDW2,TOPA,BOTA,L,REF,IREC
 963  FORMAT(2X6A2,1XA1,1XA1,1XA5,1XA5,12X2A6,1XA6,A3,2XA3,1XA3,I3,A4,I5
     1)
C                                             WRITE 1ST HEADER CARD ON OUTPUT
C                                             TAPE. VARIABLES ARE DEFINED IN
C                                             COMMENTS AT BEGINNING OF PROGRAM.
      IREC = IREC+1
      WRITE (9,965) YR,MON,DAY,HR,MIN,SITE,ISEQ,RAD1,RAD2,GRAV1,GRAV2,
     1STCD,TKCD,LTCD,NOTE,SBCD,SOCD1,SOCD2,DICD6,DICD3,SEA16,SEAX,SEA4,
```

```
     2SEA2,SEA8,IREC
      WRITE (6,965) YR,MON,DAY,HR,MIN,SITE,ISEQ,RAD1,RAD2,GRAV1,GRAV2,
     1STCD,TKCD,LTCD,NOTE,SBCD,SOCD1,SOCD2,DICD6,DICD3,SEA16,SEAX,SEA4,
     2SEA2,SEA8,IREC
 965  FORMAT(1X6A2,1XA1,A6,A3,A6,A2,1X2A3,1XA1,A4,A3,4A2,A3,2A1,A2,A1,1
     1XI5)
C                                        WRITE 2ND HEADER CARD.
      I=0
      DO 203 I = 1,L
C                                        DO LOOP PROVIDES FOR EXTRACTING
C                                        PROCESSED DATA FROM DIMENSIONED
C                                        STORAGE AND WRITING ON OUTPUT TAPE.
      IREC = IREC+1
C                                        FOLLOWING TESTS ARE MADE FOR
C                                        PREDETERMINED CARDS OUT OF PLACE.
C                                        REARRANGEMENT IS THEN ACCOMPLISHED.
      IF(IREC.EQ.11409) GO TO 3121
      IF(ISTAY.EQ.1) GO TO 3110
      IF(IREC.EQ.842) GO TO 3113
      IF(IREC.EQ.843) GO TO 3114
      IF(IREC.EQ.10266) GO TO 3115
      IF(IREC.EQ.10267) GO TO 3116
      IF(IREC.EQ.10268) GO TO 3117
      IF(IPEC.EQ.11274) GO TO 3118
      IF(IREC.EQ.11275) GO TO 3119
      IF(IREC.EQ.11398) GO TO 3120
      IF(IREC.EQ.12157) GO TO 3122
      IF(IREC.EQ.12158) GO TO 3123
      IF(IREC.EQ.13783) GO TO 3124
      IF(IREC.EQ.13784) GO TO 3125
3110  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(I),DENXS(I),
     1DENYS(I),TEMPS(I),IREC
913   FORMAT(6A2,1XA1,2X3A6,1XA6,39XI5)
      WRITE (6,969) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(I),DENXS(I),
     1DENYS(I),TEMPS(I),IREC
969   FORMAT(1X6A2,1XA1,2X3A6,1XA6,39XI5)
      GO TO 1399
3113  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(60),DENXS(60),
3113  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(60),DENXS(60),
     1DENYS(60),TEMPS(60),IREC
     1DENYS(60),TEMPS(60),IREC
      GO TO 1399
3114  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(59),DENXS(59),
3114  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(59),DENXS(59),
     1DENYS(59),TEMPS(59),IREC
     1DENYSU59),TEMPS(59),IREC
      GO TO 1399
3115  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(9),DENXS(9),
3115  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(9),DENXS(9),
     1DENYS(9),TEMPS(9),IREC
     1DENYSY9),TEMPS(9),IREC
      GO TO 1399
3116  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(7),DENXS(7),
3116  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(7),DENXS(7),
     1DENYS(7),TEMPS(7),IREC
     1DENYSY7),TEMPS(7),IREC
      GO TO 1399
```

```
 3117  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(8),DENXS(8),
 3117  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(8),DENXS(8),
      1DENYS(8),TEMPS(8),IREC
      1DENYSY8),TEMPS(8),IREC
       GO TO 1399
 3118  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(2),DENXS(2),
 3118  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(2),DENXS(2),
      1DENYS(2),TEMPS(2),IREC
      1DENYSY2),TEMPS(2),IREC
       GO TO 1399
 3119  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(1),DENXS(1),
 3119  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(1),DENXS(1),
      1DENYS(1),TEMPS(1),IREC
      1DENYS(1),TEMPS(1),IREC
       GO TO 1399
 3120  ISTAY=1
       IREC=IREC-1
       GO TO 1399
 3121  ISTAY=0
       WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(6),DENXS(6),
       WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(6),DENXS(6),
      1DENYS(6),TEMPS(6),IREC
      1DENYSU6),TEMPS(6),IREC
       IREC=IREC+1
       GO TO 3110
 3122  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(2),DENXS(2),
 3122  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(2),DENXS(2),
      1DENYS(2),TEMPS(2),IREC
      1DENYS(2),TEMPS(2),IREC
       GO TO 1399
 3123  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(1),DENXS(1),
 3123  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(1),DENXS(1),
      1DENYS(1),TEMPS(1),IREC
      1DENYS(1),TEMPS(1),IREC
       GO TO 1399
 3124  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(17),DENXS(17),
 3124  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(17),DENXS(17),
      1DENYS(17),TEMPS(17),IREC
      1DENYSY17),TEMPS(17),IREC
       GO TO 1399
 3125  WRITE (9,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(16),DENXS(16),
 3125  WRITE (6,913) YR,MON,DAY,HR,MIN,SITE,ISEQ,ALTS(16),DENXS(16),
      1DENYS(16),TEMPS(16),IREC
      1DENYST16),TEMPS(16),IREC
 1399  CONTINUE
 203   CONTINUE
       GO TO 50
 C                                       PROCESS NEXT SOUNDING.
 800   WRITE (6,918) NSET
 C                                       ERROR 800 INDICATES NON ACCEPTABLE
 C                                       FORMAT TYPE.
 918   FORMAT(1X26HSEPARATER CARD OF DECK NO.,I3,38H DOES NOT GIVE ACCEPT
      1ABLE FORMAT TYPE.)
       WRITE (6,919) ISIGN,KIND
 919   FORMAT(1X24HCOLS. 19 AND 20 CONTAIN ,A1,I1,1H.)
 801   READ (5,921) SKIP,ISIGN,KKIND
 921   FORMAT(A6,12X2A1)
```

```
      IF (SKIP.EQ.BLNK6) GO TO 802
      GO TO 801
802   WRITE (11,985) KKIND
985   FORMAT(A1)
      BACKSPACE 11
      READ (11,986) KIND
986   FORMAT(I1)
      BACKSPACE 11
      GO TO 50
C                                     IF FORMAT CANNOT BE DETERMINED, SKIP
C                                     ENTIRE DECK WITHOUT TRANSFERRING TO
C                                     OUTPUT TAPE. TRANSFER ON NEXT
C                                     SEPARATER CARD.
810   WRITE (6,950) NSET,YR,MON,DAY,Z,HR,MIN,LTR,SITE
950   FORMAT(1X36HALTITUDE MONOTONICITY ERROR-DECK NO.,I3,6H,DATE ,3A2,
     1A1,6H,TIME ,2A2,A1,6H,SITE ,A2,1H,)
C                                     ERROR 810 INDICATES ALTITUDE
C                                     MONOTONICITY ERROR.
      WRITE (6,951) ALTA,ALTB,ALTC
951   FORMAT(9X6HALTA= ,F7.2,8H, ALTB= ,F7.2,8H, ALTC= ,F7.2,4H KM.)
      GO TO 136
820   WRITE (6,960) NSET,YR,MON,DAY,Z,HR,MIN,LTR,SITE
960   FORMAT(36H DENSITY MONOTONICITY ERROR-DECK NO.,I3,6H,DATE ,3A2,
     1A1,6H,TIME ,2A2,A1,6H,SITE ,A2,1H,)
C                                     ERROR 820 INDICATES DENSITY
C                                     MONOTONICITY ERROR.
      WRITE (6,961) DENSA,DENSB,DENSC
961   FORMAT(1X7HDENSA= ,E12.5,9H, DENSB= ,E12.5,9H, DENSC= ,E12.5,11H
     1G/(CU M).//)
      GO TO 137
1000  END FILE 9
      STOP
      END
$DATA
0442
.0-+ABCYZ
GMHIKYMSTHAIWOEGFCBSSFSGSHHASASBAQCASE 34.00123490001020304O5
06070809101112131417181920212224272930484950515253545558616263646 5
'     END OF FILE CARD
'     END OF FILE CARD
```

TABLE 13

DREW'S THERMISTOR TEMPERATURE CORRECTIONS FOR ARCASONDE 1A

Height (km)	Correction (^{o}C)	Height (km)	Correction (^{o}C)
40	0	52	4.4
42	0.9	54	5.4
44	1.8	56	7.0
46	2.3	58	9.2
48	2.7	60	12.1
50	3.5	62	14.8

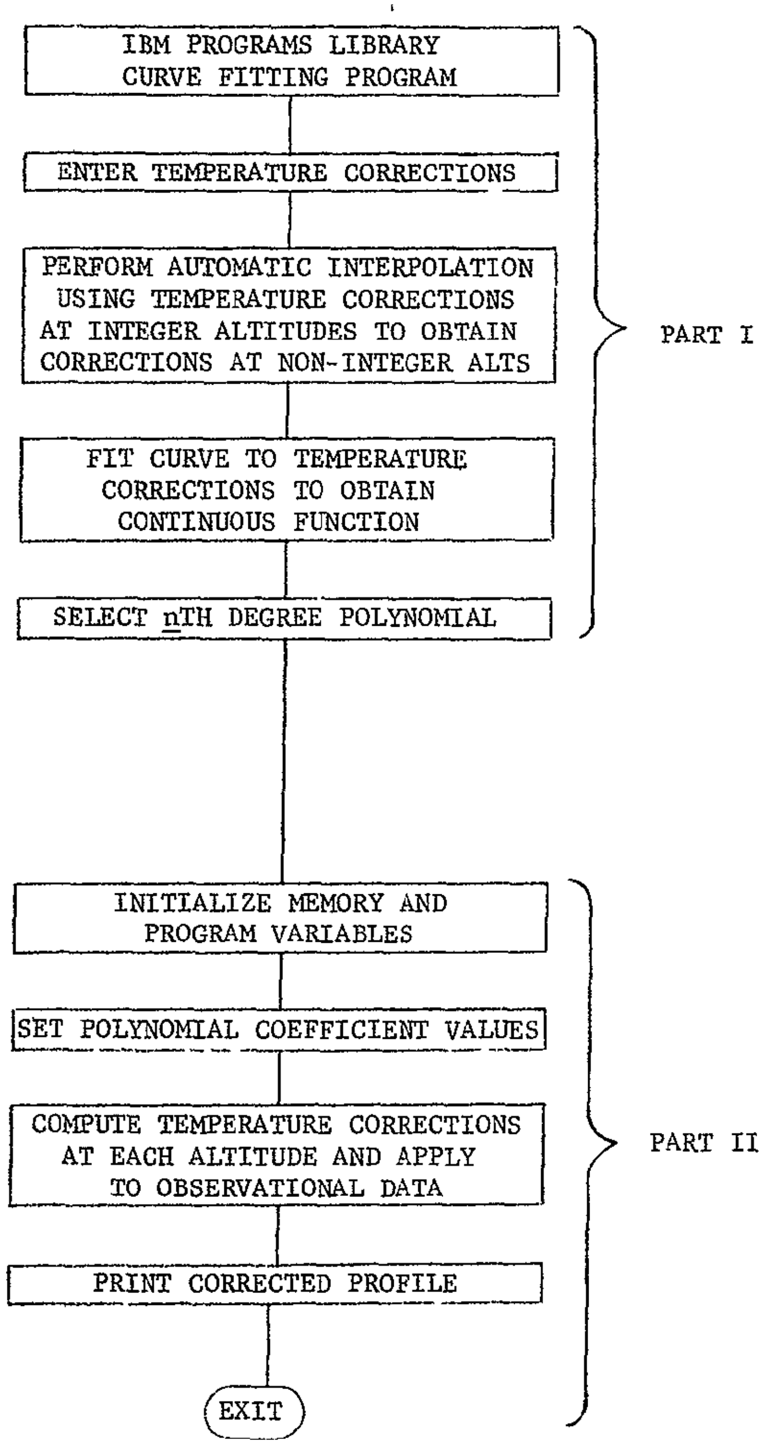

Figure 2. Simplified flow chart curve fit and temperature correction program

TABLE 14. FORTRAN IV COMPUTER PROGRAM LISTING

```
C        CURVE FITTING PROGRAM
      DIMENSION X(70),Y(70),A(10,10),SUMX(31),SUMY(15),W(70)
    1 READ (5,10) N,TOL,LAST
      DO 40 I=1,N
10    FORMAT (I4,E15.7,I4)
   40 READ (5,1063) X(I),Y(I)
 1063 FORMAT (2F4.1)
   50 DO 60 I=1,N
   60 W(I)=1.
   70 SUMX(1)=0.
      SUMX(2)=0.
      SUMX(3)=0.
      SUMY(1)=0.
      SUMY(2)=0.
      DO 90 I=1,N
      SUMX(1)=SUMX (1)+W(I)
      SUMX(2)=SUMX(2)+W(I)*X(I)
      SUMX(3)=SUMX(3)+W(I)*X(I)*X(I)
      SUMY(1)=SUMY(1)+W(I)*Y(I)
   90 SUMY(2)=SUMY(2)+W(I)*X(I)*Y(I)
      NORD=1
   93 L=NORD+1
      KK=L+1
      DO 101 I=1,L
      DO 100 J=1,L
      IK=J-1+I
  100 A(I,J)=SUMX(IK)
  101 A(I,KK)=SUMY(I)
      DO 140 I=1,L
      A(KK,I)=-1.
      KKK=I+1
      DO 110 J=KKK,KK
  110 A(KK,J)=0.
      C=1./A(1,I)
      DO 120 II=2,KK
      DO 120 J=KKK,KK
  120 A(II,J)=A(II,J)-A(1,J)*A(II,I)*C
      DO 140 II=1,L
      DO 140 J=KKK,KK
  140 A(II,J)=A(II+1,J)
      S2=0.
      DO 160 J=1,N
      S1=0.
      S1=S1+A(1,KK)
      DO 150 I=1,NORD
  150 S1=S1+A(I+1,KK)*X(J)**I
  160 S2=S2+(S1-Y(J))*(S1-Y(J))
      B=N-L
      S2=(S2/B)**.5
  163 WRITE(6,13)
   13 FORMAT (2X4HNORD8X3HTOL13X2HS210X)
      WRITE(6,14) NORD,TOL,S2,N
   14 FORMAT (I6,2XE14.7,2XE14.7,I6)
      DO 164 I=1,L
      J=I-1
```

```
 164 WRITE (6,10) J,A(I,KK)
 167 DO 169 I=1,N
     S1=0.
     S1=A(1,KK)
     DO 168 J=1,NORD
 168 S1=S1+A(J+1,KK)*X(I)**J
     S3=Y(I)-S1
 169 WRITE (6,11) X(I),Y(I),S1,S3
  11 FORMAT(E14.7,2XE14.7,2XE14.7,2XE14.7)
     IF (NORD-LAST) 170,173,173
 170 IF (S2-TOL) 173,173,171
 171 NORD=NORD+1
     J=2*NORD
     SUMX(J)=0.
     SUMX(J+1)=0.
     SUMY(NORD+1)=0.
     DO 172 I=1,N
     SUMX(J)=SUMX(J)+X(I)**(J-1)*W(I)
     SUMX(J+1)=SUMX(J+1)+X(I)**J*W(I)
 172 SUMY(NORD+1)=SUMY(NORD+1)+Y(I)*X(I)**NORD*W(I)
     GO TO 93
 173 WRITE (6,1064)
1064 FORMAT(1H1)
     STOP
 499 FORMAT(E14.7,1XE14.7)
  12 FORMAT (E14.7,I6)
 002 FORMAT(F7.2,1XF7.2,1XF7.2)
     END
```

```
C PROGRAM TO APPLY DREWS TEMPERATURE CORRECTION TO THERMISTOR ROCKET
C DATA AND CHANGE TO DEGREES K
C BLANK CARD AT END OF DATA TO EXIT PROGRAM
C P. MORGENSTERN            8/13/68
      INTEGER OUT1,OUT2
      DIMENSION ID(4)
      A0=-.2131502E+03
      A1= .1343149E+02
      A2=-.2848612E+00
      A3= .2057881E-02
      IN1=5
      OUT1=6
      OUT2=7
1     DO 2I=1,500
      READ (IN1,101) (ID(J),J=1,3),H,T,ID(4)
101   FORMAT (3A5,F6.1,11XF7.1,A4)
      IF (H) 10,10,3
3     IF (H-40.) 4,4,5
5     T=T-(A0+H*(A1+H*(A2+H*A3)))
4     T=T+273.2
      WRITE (OUT1,101) (ID(J),J=1,3),H,T,ID(4)
      WRITE (OUT2,101) (ID(J),J=1,3),H,T,ID(4)
2     CONTINUE
10    STOP
      END
```

this program is shown in Figure 2 In Part I of this program, an automatic interpolation scheme provides a method for using Drew's temperature corrections at integer altitudes to obtain corrections at any non-integer altitude. This is accomplished by fitting a curve to Drew's corrections, thereby approximating these corrections by a continuous function A standard curve fitting program available through the IBM programs library was used. This program provides an $\underline{n}$th degree polynomial

A trial case was run varying the equation degree from $\underline{n} = 1$ through $\underline{n} = 5$. Inspection of the results indicated that a value of $\underline{n} = 3$ provided the best fit to the correction data The polynomial thus obtained is as follows.

$$\Delta T(H) = a_o + a_1 H + a_2 H^2 + a_3 H^3 \tag{1}$$

where

ΔT = Drew's temperature correction (^{o}C)

H = height (km)

a_o = 213 1502

a_1 = 13 43149

a_2 = 0.2848612

a_3 = 0.002057881

The continuous temperature-correction function obtained in this manner was then applied in Part II of the computer program, in which the Croatan data was first corrected accordingly and then converted to the Kelvin scale.

As mentioned previously, it is apparent that the specific correction discussed here applies only to Arcasonde 1A type thermistor measurements. Consequently for all subsequent thermistor data that is collected, it will be necessary to determine whether corrections have already been made, and if not, to apply the appropriate corrections. It is anticipated that where such other corrections are necessary for instruments other than the Arcasonde 1A type, the corrections can be accomplished simply by changing the values of the coefficients in Equation (1).

2. <u>Smoothing of Correlations Between Atmospheric Density and Solar Flux</u>. During an earlier program, density-altitude profiles from

the original sounding-data inventory were statistically studied for variations associated with solar flux variations Results have been reported elsewhere (Ref. 13). The analysis procedure used in that study consisted of calculating the vertical profile of the coefficient of correlation (linear) between atmospheric density and the 10 7 cm solar flux density.

Interpretation of computed correlation coefficients requires establishment of the statistical significance of these values. In the absence of a priori knowledge for the population correlation coefficient, the null hypotehsis of no significant different from a population correlation of zero may be tested. Any significant departure from this hypothesis may be indicative of a relation between solar flux and atmospheric density.

The exact distribution of the correlation coefficient for small samples originally derived by R. A. Fisher has been tabulated by David (Ref. 14). Based on these tables an empirical function was derived to aid in calculating fiducial limits for the correlation coefficient as a function of sample size. For the 5 percent and 95 percent confidence belt to test the significance of the sample correlation coefficient with an assumed population of zero, these limits are given by

$$R = \pm 1\ 89 n^{(-0\ 535)} \qquad (2)$$

where R is taken as the upper or lower limit depending upon the sign, n is the sample size

This function, then, was used to interpret the significance of the correlation coefficient profiles.

The procedure consisted of testing the significance of the calculated value for the correlation coefficient (unsmoothed) at each 1-km altitude interval of the profile, i e , using the output of the correlation coefficient program. If the calculated value of the correlation coefficient exceeded the confidence limit value, then the null hypothesis of no significant difference from a population correlation of zero must be rejected

Considerable scattering of points in the correlation coefficients exists owing to sampling fluctuations. In the present procedure, the z-transform method was applied to smooth the correlations of solar flux with density using 5 km running averages.

The z-transform, developed by Fisher (Ref. 15), is a transformation from r to a quantity z, which is distributed almost normally with variance and practically independent of the value of the correlation in the population from which the sample is drawn It is recalled that r is bounded by $\pm$ 1 and averaging is not appropriate near these limits. The z-transform of r

$$z = \frac{1}{2} \left[\log_e(1 + r) - \log_e(1 - r)\right] \tag{3}$$

is taken on individual correlations, the weighted average of the z's is formed to obtain $\bar{z}$ and an inverse transform of $\bar{z}$ is performed to obtain $\bar{r}$.

A program was written in Fortran IV for the IBM-7094 computer that calculates 5 and 95 percent confidence limits, tests the individual correlations for statistical significance, and smooths the correlations using the z-transform method. This porgram is listed in Table 15 preceded by a flow chart in Figure 3.

Examination of preliminary results from this analysis tend to give some preliminary support to the proposed model for the effects of solar flux anomalies on atmospheric density variations below 200 km.

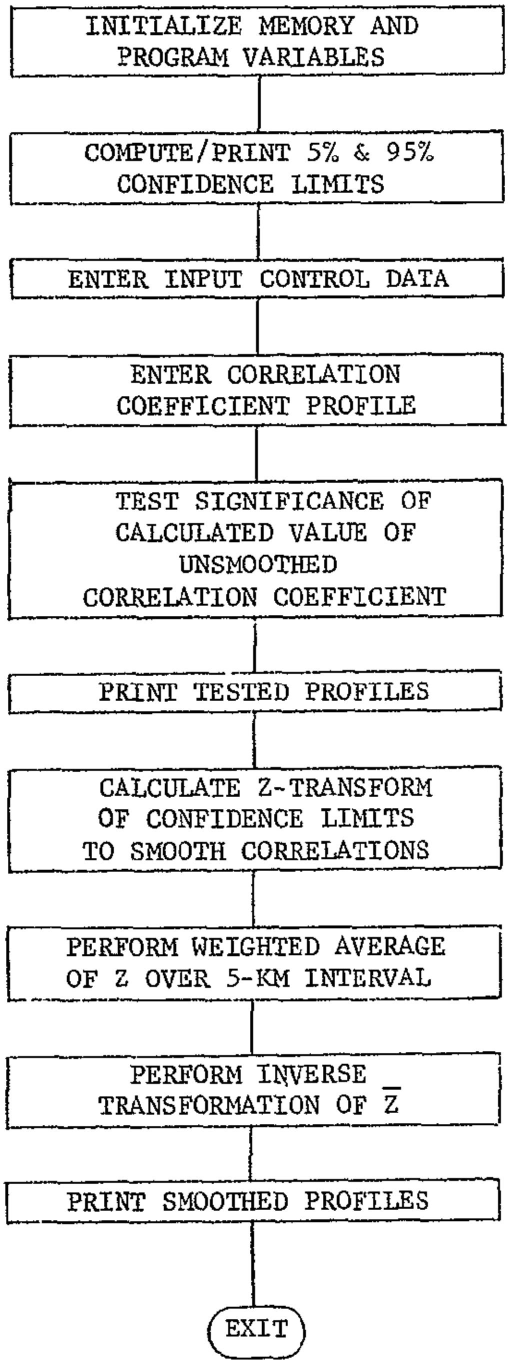

Figure 3. Simplified flow chart correlation smoothing

TABLE 15. FORTRAN IV COMPUTER PROGRAM LISTING

```
C      PROGRAM TO SMOOTH CORRELATIONS OF SOLAR FLUX WITH DENSITY USING
C      5-KM RUNNING AVERAGE.  INDIVIDUAL CORRELATIONS ARE CONVERTED BY
C      FISHERS  Z TRANSFORM, THE WEIGHTED AVERAGE IS FORMED AND THEN
C      AN INVERSE TRANSFORM IS APPLIED TO THE AVERAGE.  PROGRAM
C      CALCULATES 5 AND 95 CONFIDENCE LIMITS AND TESTS THE INDIVIDUAL
C      CORRELATIONS FOR SIGNIFICANCE.  EACH SIGNIFICANT VALUE IS
C      MARKED BY AN * IN THE OUTPUT.  A CARD WITH 1 IN COLUMN 1 IS USED
C      TO SEPARATE CASES.  A NUMBER GREATER THAN 1 IS USED TO EXIT THE
C      PROGRAM
C      P. MORGENSTERN   6/17/68
C
       DIMENSION CORR(5,2),N(5),Z(5,2),SUM(2),ZBAR(2),X(2)
       DIMENSION R(320),LIMIT(2)
       DIMENSION RBAR(2)
       EQUIVALENCE (SUM(1),X(1),RBAR(1))
       INTEGER HEIGHT,STAR,BLANK
       K=6
       L=5
C                              CALCULATES 5 AND 95 PERCENT CONFIDENCE
C                              LIMITS
       DO 15 I=4,320
       XN=1
       A=1.889559
       B=-.53502648
15     R(I)=A*XN**B
       WRITE (K,105) (R(I),I=4,320)
105    FORMAT (15F8.3)
       READ (1,104) STAR,BLANK
104    FORMAT (2A1)
1      DO 2 I=1,5
       DO 3 J=1,2
       SUM(J)=0.0
3      CORR(1,J)=0.0
       READ (1,101) INDEX,HEIGHT,ID1,ID2,(CORR(I,M),M=1,2),N(I)
101    FORMAT (I1,I3,2A3,2F6.3,I4)
       IF (INDEX-1) 2,1,14
2      CONTINUE
       WRITE (K,103)
103    FORMAT (1H1)
       HEIGHT=HEIGHT-5
       DO 16 I=1,2
       DO 19 M=1,2
       LIMIT(M)=BLANK
       NN=N(I)
       Y=ABS(CORR(I,M))-R(NN)
       IF (Y.GT.0.) LIMIT(M)=STAR
   19  CONTINUE
       HEIGHT=HEIGHT+1
16     WRITE (K,102) HEIGHT,ID1,ID2,(CORR(I,M),LIMIT(M),M=1,2),N(I)
       HEIGHT=HEIGHT+3
11     SUMN=0.0
       DO 4 J=1,2
       DO 4 I=1,5
       EN=N(I)-3
       IF (EN) 6,6,7
```

```
C                               CALCULATES Z TRANSFORM
7     Z(I,J)=.5*ALOG((1.+CORR(I,J))/(1.-CORR(I,J)))
      SUM(J)=SUM(J)+Z(I,J)*EN
      SUMN=SUMN+EN
4     CONTINUE
      GO TO 10
6     DO 8 I=1,4
      N(I)=N(I+1)
      DO 9 J=1,2
      CORR(I,J)=CORR(I+1,J)
9     SUM(J)=0.0
8     CONTINUE
      READ (L,101) INDEX,HEIGHT,ID1,ID2,(CORR(5,M),M=1,2),N(5)
      IF (INDEX-1) 11,1,14
C                               AVERAGE Z OVER 5-KM INTERVAL
10    DO 12 J=1,2
      ZBAR(J)=SUM(J)/SUMN*2
      X(J)=EXP(2.*ZBAR(J))
C                               INVERSE TRANSFORM OF ZBAR
12    RBAR(J)=(X(J)-1.)/(X(J)+1.)
      I=3
      DO 17 M=1,2
      LIMIT(M)=BLANK
      NN=N(I)
      Y=ABS(CORR(I,M))-R(NN)
      IF (Y.GT.0.) LIMIT(M)=STAR
17    CONTINUE
      HEIGHT=HEIGHT-2
      WRITE (K,102) HEIGHT,ID1,ID2,(CORR(3,M),LIMIT(M),M=1,2),N(3),
     1(RBAR(M),ZBAR(M),M=1,2)
102   FORMAT (I4,2A3,2(F7.3,A1),I4,2(F7.3,E15.7))
      GO TO 6
14    DO 18 I=4,5
      HEIGHT=HEIGHT+1
      DO 20 M=1,2
      LIMIT(M)=BLANK
      NN=N(I)
      Y=ABS(CORR(I,M))-R(NN)
      IF (Y.GT.0.) LIMIT(M)=STAR
   20 CONTINUE
18    WRITE (K,102) HEIGHT,ID1,ID2,(CORR(I,M),LIMIT(M),M=1,2),N(I)
      STOP
      END
```

IV. PLANS FOR FURTHER PROCESSING

The present document is an interim report reflecting work performed over a twelve-month period Accordingly, it has discussed, thus far, only part of the overall program. This section includes a discussion of plans for continued processing of the data in the original 442 sounding inventory as well as that currently being collected and Meteorological Rocket Network data

A. Data Collection

Data collection as discussed in Section IIA will continue. As before, the data will be keypunched into a standard format compatible with the previous data and suitable for computer processing. The new data will be screened for publication and keypunching errors

As mentioned earlier, data from many of the non-Soviet soundings that occurred during the period 1962-1967 have been acquired In addition to the acquisition of the more recent data and investigation of any further possible assistance in obtaining Soviet data, immediate emphasis is to be placed on tracing down those soundings between about 1957 and 1963 which are listed in the World Data Center A Catalogues without identification of experimenter or his affiliation

B. Further Data Processing

In Section III certain initial processing steps were discussed with respect to the original data inventory With regard to programming and non-programming efforts, immediate attention is to be directed toward further processing of this data along with newer sounding data. These steps, directed toward preparing the data for statistical analysis, will include:

(1) Review of original data inventory sources

  a. Add observational temperature and pressure data

  b. Retrieve lost significant figures

(2) Conversion of physic units

(3) Additional sounding consistency tests

(4) Addition of geomagnetic index data to the header records

(5) Conversion from geometric to geopotential altitudes

(6) Interpolation to integral geopotential kilometers

As mentioned earlier, the original data inventory transferred to tape contained only altitude-density profiles and only in some cases, temperature data Temperature and pressure data were generated from the density profile. Consideration is being given to reviewing the original publications in order to (1) obtain observation temperature and pressure data if available, and (2) retrieve significant figures in the density data which were lost in some cases during the original transcription from source to cards.

The physical units of the measured data vary from author to author To achieve a consistent system of units, and to minimize the chance of errors due to copying, a computer program will convert any combination of given units to a standard set: altitude - (geometrical) kilometers, temperature-degrees Kelvin, density-kilograms per cubic meter, and pressure-newtons per square meter

If all three variables, temperature, density, and pressure, are available, a programmed gas-law consistency test can be performed This test should be made at each altitude from the top altitude down through the complete profile.

The density-altitude profiles will be used with appropriate integration procedures involving the hydrostatic equation to derive running temperature-altitude profiles, and, with the aid of the gas law, to derive pressure-altitude profiles The derived profiles can be compared with both the U.S. Standard Atmosphere and the values of temperature and pressure published by the original source These comparisons can detect gross errors in the density profile as well as identify anomalous individual data.

If errors are detected, a printout will occur showing the absolute error and the magnitude of the percentage error. Consideration is being given to the details of appropriate corrections of such errors as they occur. In addition, consideration is being given to constructing tests when one or more variables are missing in the original source. The principal objective of the testing programs is to achieve data sets that are internally consistent for processing in the next and subsequent phases.

Geomagnetic index values are to be included in the sounding header records for use in the statistical analysis of these data Four 3-hour values will be entered for each sounding to investigate possible lag relationships with respect to the atmospheric density variations

After all screening, conversion, editing, checking and testing have been effected and necessary corrections made, the original data decks will be converted into operational decks in terms of geopotential altitude for the appropriate launch sites. Interpolation to integral geopotential-kilometer altitudes will be made for all parameters including any and all derived data.

Consideration is also being given to the merits of maintaining on tape an intermediate set of data, containing all measured and derived data interpolated to integral geometric kilometer altitudes. Such a set could be useful for the sake of completeness, for any subsequent publication, or for future analysis.

C. Meteorological Rocket Network Data

An appreciable amount of important atmospheric variability data has been accumulated during the present and previous studies from various scientific literature sources and through personal communications with individual experimenters. A much larger inventory of rocket sounding data is contained on a series of magnetic tapes maintained by the Meteorological Rocket Network (MRN), some of which the NASA technical monitor has recently obtained.

Since the validity of a statistical study of the atmospheric variability necessarily depends on the data sample sizes, it is felt that immediate priority should be given to the MRN tapes. Accordingly, the emphasis of the Model Atmospheres study should now reflect a concentrated effort to develop techniques for processing the MRN data, specifically for checking, editing, error correction, and for normalization of the data to a common format.

As a fallout of this processing and owing to the increasing number of errors discovered on the MRN tapes, it is further felt that a formal report itemizing such errors would be of prime importance to the scientific community concerned with this source of data.

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